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Engine Bed and Cylinder Tools.
A New Automatic Die.
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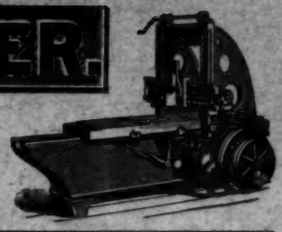

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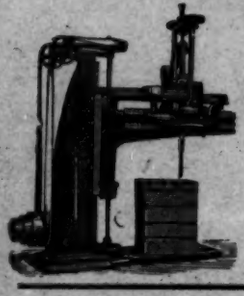

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Bicycle Tools—XI.

WOOD RIM DRILLING.

In describing the method of setting the Fox and all similar two-spindle rim drilling machines for accurate spacing, I find I made some errors and the directions should read as follows:

Set the index pin in the circle of holes desired; set the points of the drills to the dividers; the dividers being set, either by trial or from a previous record to step around the circumference of the rim with the required number of divisions; in setting the drill spindles see that the angles are correct; the angles can be had from a table; in the Fox machine there is also a "pendulum" to assist in this operation; the correct angles may also be found by dividing 360 degrees by the number of holes to be drilled. In setting with the dividers, see that each drill point stands the same distance, as nearly as possible, from the middle index pin; next make a mark in the rim on the chuck with the middle index pin, and also with each drill point, three marks in all, then take the rim off the chuck, turn it over, and if the three marks coincide with the middle index and drill points when the rim is rechucked then the distance is evenly divided; now move the chuck index pin into the next index hole, and if one drill point comes exactly to the mark made by the other drill, then the setting is correct. But even then it is well to go round the rim once with light marks, same as around a gear blank in gear cutting, and see that the spacing comes all right.

In describing the "Schacht" 18 spindle rim drill construction; I said that the chuck was operated with a cone, screw, and hand nut. In the "Schacht" built by the Schlueter Mfg. Co., Cincinnati, the 18 (or less) drill spindles are inside the rim; the number of drill spindles can be greater or less as desired, and the spindle stocks can be put anywhere on the flat table which supports them; it is the drill spindle feed that is operated with the cone, screw, and hand nut, not the chuck.

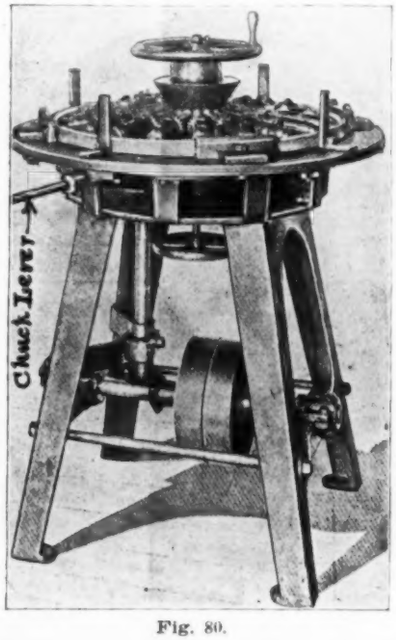


Fig. 80.

The machine does not include such adjustments as would enable tangent spoke holes to be drilled, and as it drills from the inside of the rim outward it cannot drill and countersink for the nipple washer at one operation, as all the drillers do which enter the drill on the outside of the rim. This would cause a second handling of the rim in the countersinking machine, and, at the very best, individual countersinking of the holes would take so much time that the saving gained by the multitude of spindles in the "Schacht" would be very considerably reduced, if not caused to disappear altogether. This countersinking for the nipple washer is sometimes flat and sometimes concave, or "globed out," to permit correct nipple direction. The drills and countersinks used will be referred to later.

The Schacht machine is shown in Fig. 80.

The Pratt & Whitney machine has been previously illustrated and described in the "Machinist," and an extended description is not needed. The machine is designed to drill rims 12 to 27 inches diameter, with from 20 to 40 holes. The cam actuated chuck jaws are 10 in number and give 20 points of contact on the rim, thus ensuring the full support needful for uniform countersinking. The spindle quills have the usual rack and pinion feed, and the two pinions are connected by a

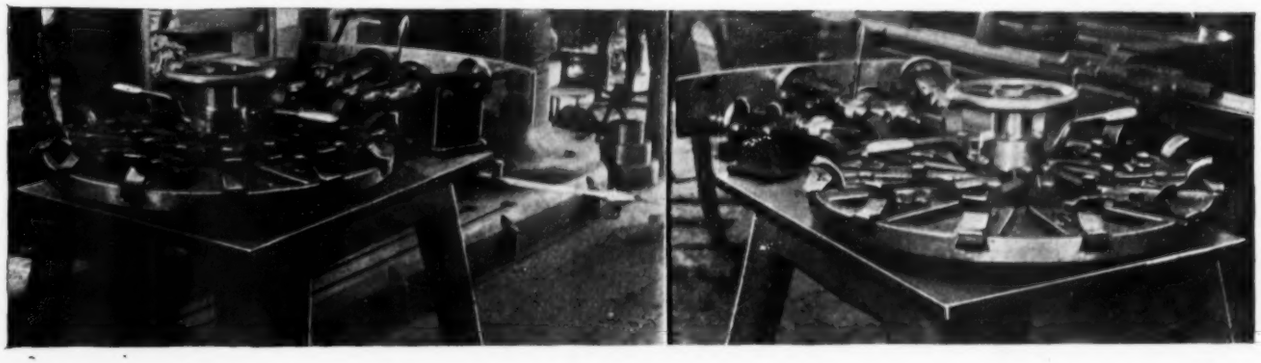


Fig. 82. RIM-DRILLING MACHINES. Fig. 83.

universal coupling so as to be both operated by one hand lever. The indexing and locking device is treadle actuated, and the workmanship is Pratt & Whitney's. The spindles are driven with one round belt for both, and the idlers are carried on a hinged stand which can be adjusted to secure proper belt tension in any spindle position within the range of spindle adjustment.

Figs. 82, 83, show the "Wilmarth" rim drilling machine.

This machine in its design presents an active departure from all others, and is based on a full appreciation of the fact that a tangent spoke wheel rim, correctly drilled, has for the holes a uniformly recurrent sequence of four holes, each one of each group of four holes standing at an angle of its own, different from the angle of any other hole in that group.

The "Wilmarth" driller can drill a rim correctly by indexing once around the rim, without turning the rim over.

The tangent spoke wood rim wheel is the stiffest and strongest structure for its size and weight now made, and hence represents the utmost advance of the mechanic arts in the way of distribution of material to resist load and shock in two directions—sidewise and from the circumference toward the center. At the Liberty cycle shops there is a photograph of four men standing on the flat of a cycle wheel laid down on four rim supporting blocks. The men all stand fairly on the spokes, and the wheel supported this load without permanent distortion or "set."

Wilmarth recognized this sequence of four spoke holes in the cycle rim, each of the four at an angle of its own, and, therefore, gave his rim driller four spindles, and mounted the drill stocks adjustably each on the upright face of a separate angle plate, and adjustably secured the under flat horizontal face of each angle plate to the flat horizontal bed plate of his machine, thus making it possible to make each drill spindle stand on both the "spread" and the "tangent" angles of a cycle wheel spoke. He then arranged the angles plates arc-wise on his bed plate, and equipped the bed plate with toggle actuated chuck jaws jointed to a common central member, operated with two handles, and provided with a hand wheel clamping nut, all as shown in Figs. 82 ,83, the chuck having range enough to take the usual sizes of rims, with a jaw adjustment. The hand wheel clamping nut holds the chuck jaws firmly to any size of rim within the chuck range. Wilmarth then added a fifth drill spindle to drill the air tube hole which is required in each rim, and the drilling of which is not provided for in any other rim drilling machine within my knowledge. In all cases of actual practice so far observed, the air tube hole is drilled on a separate machine, and by a hand who must be part of the time employed on other work. So far Wilmarth surrounded the conditions with appropriate and well considered elements. He added coiled springs to his drill spindles for the return travel, and then placed a vertical segmental plate A behind or outside of his spindles, large enough to cover them all and mounted this plate A on a radial slide on the under side of the bed plate of the driller, and arranged the hand lever B, Fig. 82, to move the feed plate A inward by pulling on the handle. The air hole drill spindle is worked by a small upright hand lever C.

The chuck revolves easily on a ring of 62 balls 5-16-inch in diameter. The chuck jaw carriers are dovetailed in place. The indexing is by a treadle-withdrawn pin.

The makers claim a production of 800 to 1,100 rims in 10 hours, all complete, countersinking and air holes, everything done.

The spindles have globed rear ends, and to these globes are fitted short cylindrical shoes sliding on their bases on the curved inside of the segmental feed plate A. The spindle retracting springs are of rather heavy brass wire, and the feed takes quite a heavy pull on the hand lever, B.

In regard to setting all of these multi-spindle rim drills for different sizes and numbers, it is clear that a model rim of each sort required should be drilled, and that this model should be used for setting the spindles instead of dividers and so on. With a drilled model rim any fairly intelligent hand could set any of the machines described in a few minutes, and I have been much surprised to notice that such models are not invariably used, although many shops have them, without a doubt.

HUGH DOLNAR.

A New Automatic Die.

A new die, which has been designed especially for use with the flat turret lathe, is shown by the accompanying engravings, and we believe the die will be found to possess a number of features of interest to those who know something of the difficulties of producing fairly accurate threads with dies, and how near the average die-cut thread approaches the lathe-cut thread in points of accuracy of size, lead and shape.

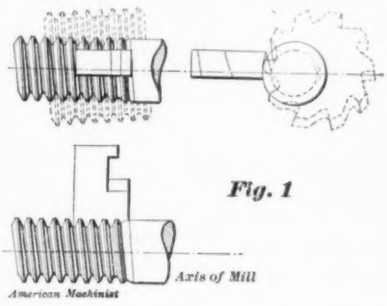
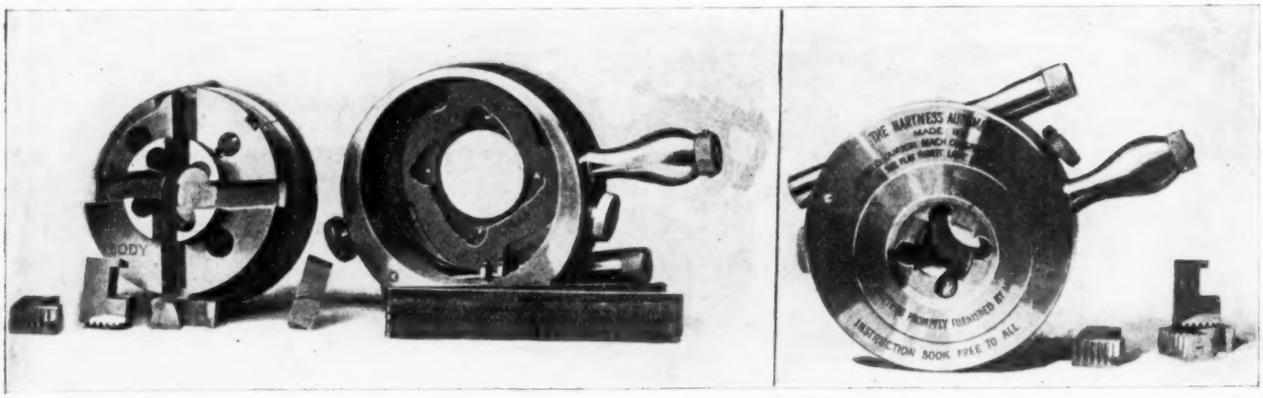


Fig. 1



A NEW SCREW CUTTING DIE.

Referring first to Fig. 1; this shows the form of chaser used, and also the method of producing it—a method which differs radically from the usual one. The ordinary hob used in chasing dies is without clearance in the threads and forms the threads in the die chasers by what may be called something of a jamming operation, especially when the hob is somewhat dulled. The burnished and more or less strained surface of the steel in the threads is therefore distorted in the hardening operation more than would be the case if it were cut to shape with a clean-cutting tool, and this distortion is sometimes sufficient to destroy clearance at the cutting edge, and to impair the accuracy of form of thread and lead—to say nothing of

the fact that a chaser in one side of the die harder than the one opposite always makes the die run out of true. These and other considerations, which will appear later, led to the abandonment of the hob and the substitution of a milling cutter, and the approximate position of this milling cutter with respect to the chaser is indicated by the dotted outlines in Fig. 1. The milling cutter is not threaded, as a chaser or hob would be, but has grooves, the proper form to produce the threads, running straight around it, and, when in operation, is set to the proper angle for the lead of the thread, as indicated. The cutter is 2½ inches diameter for all dies for threads varying in diameter from ¼ inch to 1¼ inches, and is backed off in a backing-off lathe so that it has clearance in the threads. It is sharpened by grinding the front faces of the teeth.

The machine in which this milling cutter is used has been constructed especially for the purpose, and has dials so arranged that all settings can be recorded and reproduced at any time, so that chasers can be duplicated. The setting of the cutters is such that the die has cutting clearance in front, which clearance gradually diminishes, and at the rear portion disappears entirely, the threads at that point acting simply as a nut to draw the die on and to insure accurate pitch. The dotted outlines in Fig. 1 clearly indicate how this effect is produced, the two small circles in the end view at the right indicating the relative positions of the center of the cutter at each end. Though with the large mills used the difference in clearance is, of course, very slight, it is yet sufficient, as experience has shown, to produce important results in the action of the die. In practice it is the aim to have the back of the chasers bear rather hard upon the screw, in order to the more perfectly control the leading action of the die.

The chasers are held to their work when cutting by the cam ring shown, which is turned by the outer eccentric ring to which the handle, H, is attached, this handle serving to close the die by hand, and having within it a spring stop-pin, which defines the position of the ring when the die is closed. By turning this stop-pin within the handle two different settings are secured, the first of which may be used for a roughing cut if desired. The exact sizing of the die is secured by turning the screw S, which has formed upon it the single ring shown, which has the form of a rack tooth, and engages with a gear-tooth formed on the cam ring. It will be noticed that the cam ring is applied to the chaser just above where the heaviest of the cut comes, and the chasers are therefore solidly supported by the cam-ring and the eccentric ring outside of it.

The body of the die is held in position on the shank by what may be called a universal joint, which allows it to adjust itself to the work in the same manner as has been found necessary in the case of reamers and taps used in the turret machine, where it is important that the size of the holes reamed or tapped shall be exactly to size. The die is held in position upon a flat surface by two springs, which are weak enough to allow the work to control the position of the die, and it is driven by two balls, which are placed diametrically opposite each other in holes which are drilled half in the shank and half in the die body at the back, as indicated by B, at the left of Fig. 2.

A notable feature of the die is its compactness; a die for cutting threads up to 1¼ inches diameter being only 5½ inches

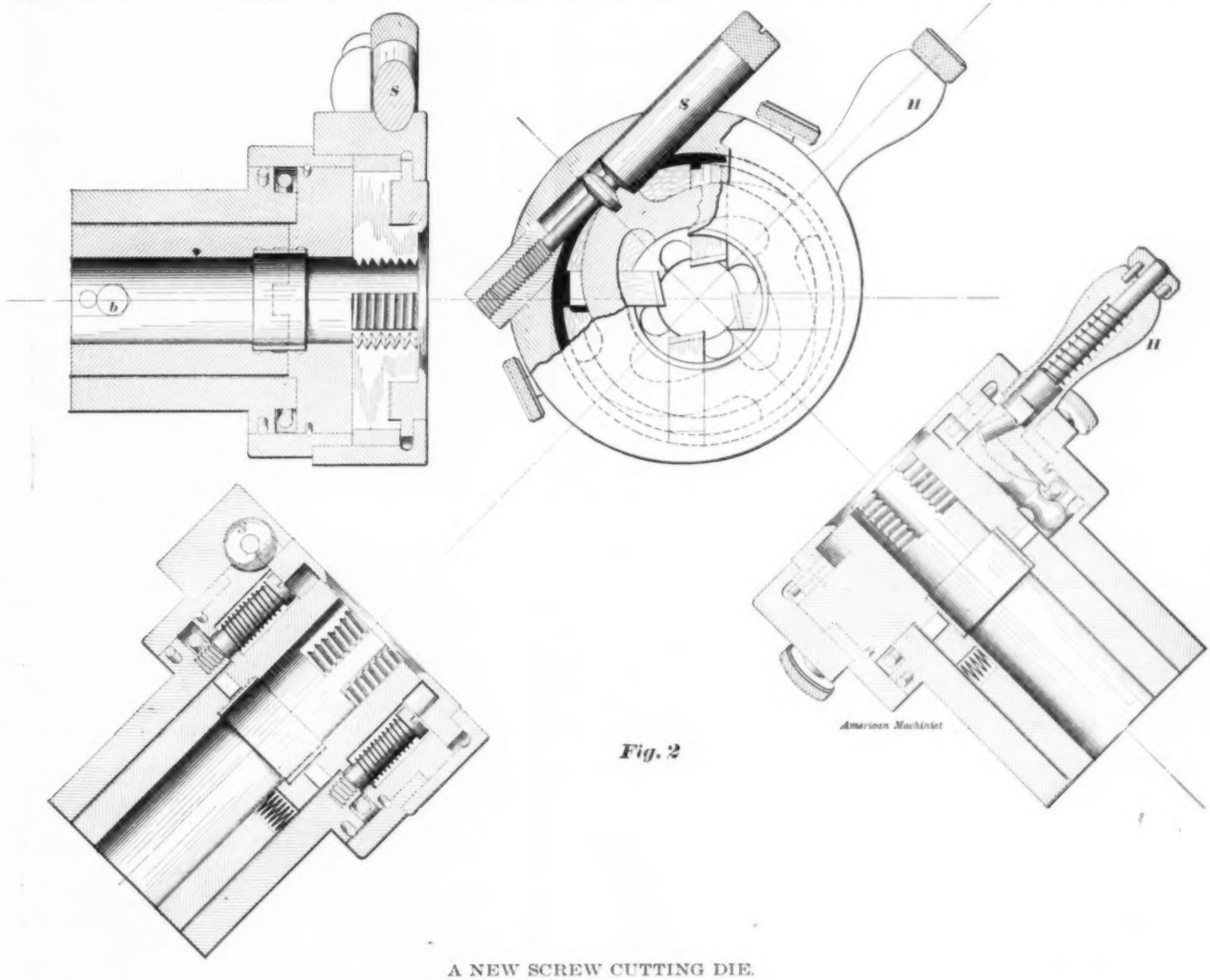


Fig. 2

A NEW SCREW CUTTING DIE.

diameter, and the length of the die body proper, about 2½ inches. Its flexible shank, which adapts it to the flat turret lathe is 2½ inches long and 3 7-16 inches diameter.

All parts of the die are made by special machinery, and are interchangeable. The cam and die body, chasers, pins, springs, etc., are made of tool steel; all of the other parts are made from forged, or bar open hearth steel. The die is made by the makers of the turret lathe referred to, the Jones & Lamson Machine Co., Springfield, Vt.

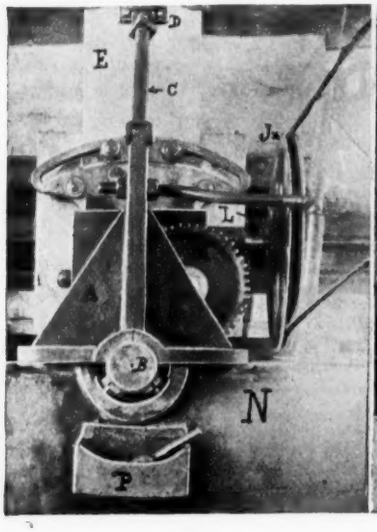


Fig. 1.

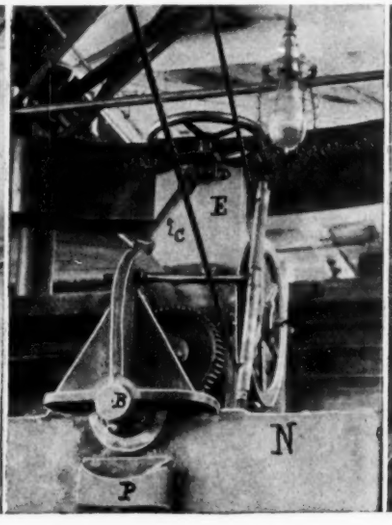


Fig. 2.

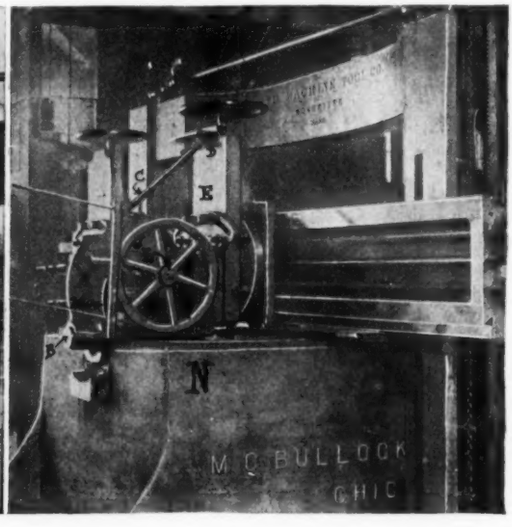


Fig. 3.

BORING ATTACHMENT TO PLANER.

Engine Bed and Cylinder Tools.

The Planer as a Boring Machine.

For years I, myself, ran iron planers in the days when a machinist would have scorned the thought of handling more than one tool except in case of an emergency, and then only as a condescending favor to some specially deserving and meritorious foreman, or perhaps in acquiescence to the meek supplication of an employer; in those days the zealous youth who kept two self-acting machines in operation was pretty sure to be admonished by some "old hand" usually of English extraction, that he was "spoiling trade," that one tool was enough for any self-respecting artisan to handle, and that if the shop wanted more tools to run, it was the shop's place to put on more men to run them. So in those days of long cuts (single tool of course), I had plenty of time to think, and I used to imagine all sorts of possible lathe and planer constructions and attachments, and while away the long hours of the day in which I had only to grind and set a tool a few times, with my note book and pencil sketches of things unseen. I really believed I thought of almost everything that could be done with a planer. Some way that belief has clung to me through all the years that lie between then and now, and until last week I never had a really clear idea of its absurdity. But when I saw a planer in the shops of M. C. Bullock Mfg. Co., at Chicago, boring an engine bed I did realize that there were things, and really useful things, capable of wide application too, within the capacity of a common iron planer of which I knew nothing whatever.

To make a boring mill out of a planer, there must be something to carry a boring tool around in a circle; if the hole is not a full circle, but only a segment, and is large enough, and if the planer tool saddle is provided, as many of the shapers are, with a segment of worm gear driven with a tangent screw or "worm" and hand crank, then a pretty good curved surface can be made with a tool in the tool post. Not very good, but pretty good But if the hole is entirely enclosed by metal walls, or if the diameter is small and the open hole or segmental surface is of a radius too small to let the tool supporting parts pass, then the single tool held in the usual manner cannot be used to finish it.

The "Willans" Bullock engine is designed for very high speed and demands the utmost accuracy of construction; it is very simple, but its simplicity is not to be trifled with, and the shaft bearing must be absolutely parallel with the planed surface of the engine base. It is within the

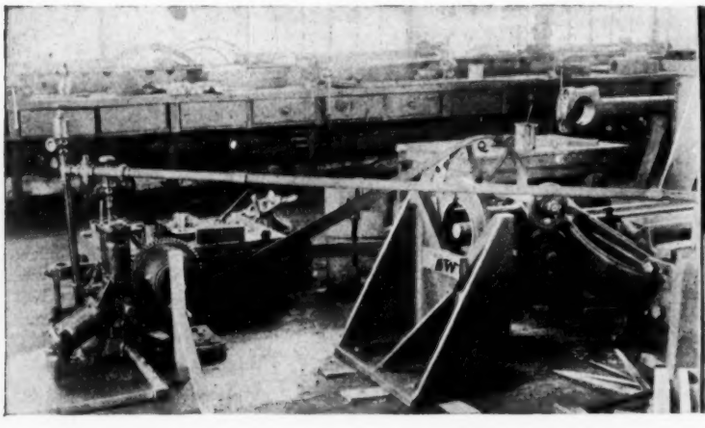


Fig. 4.

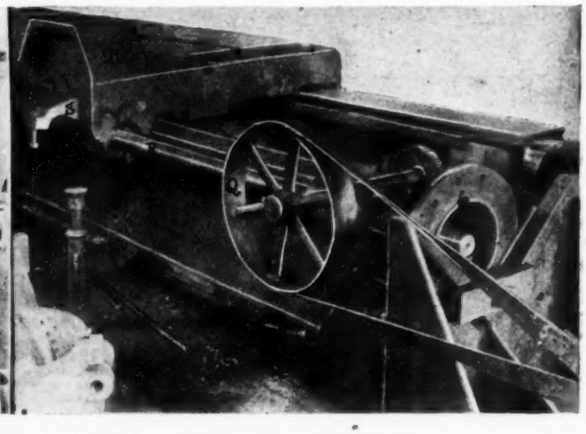


Fig. 5.

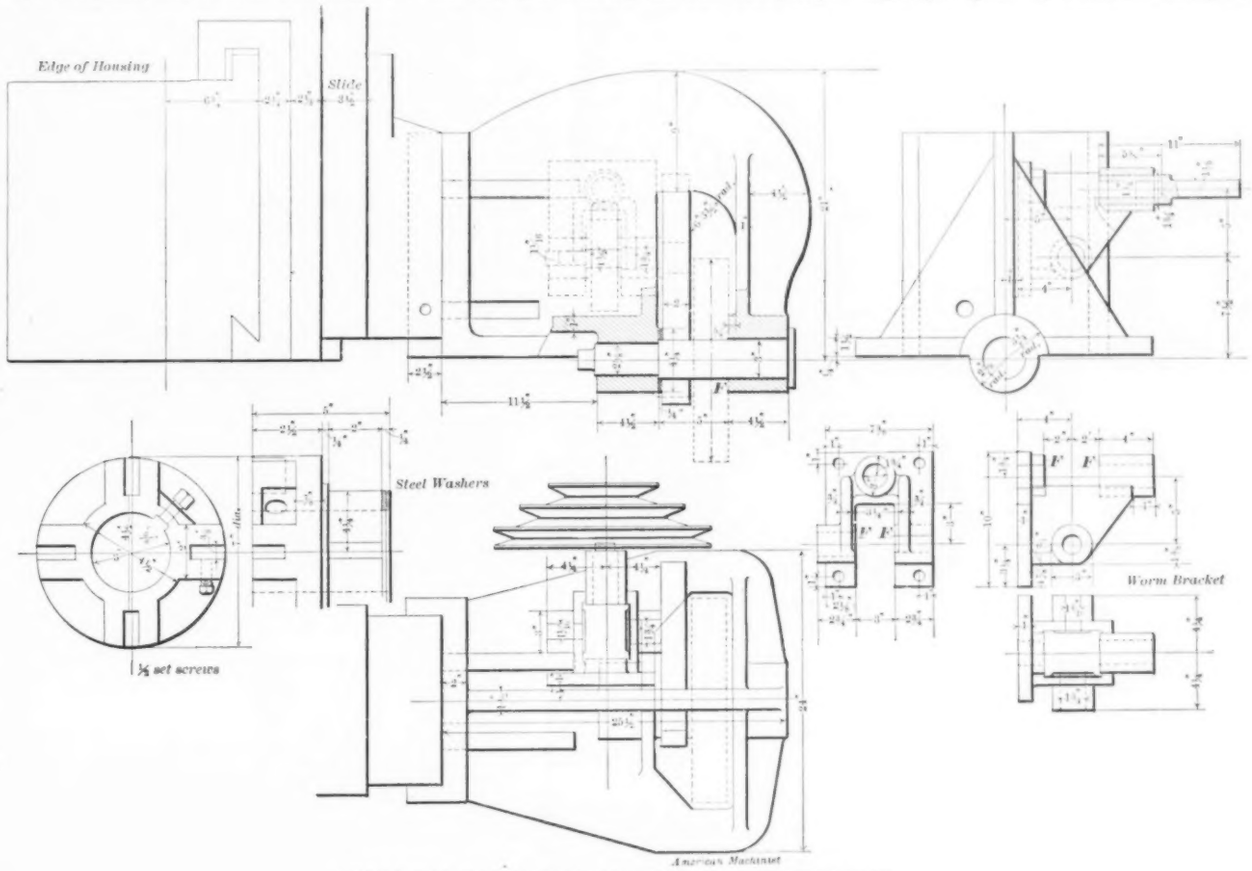
BORING ATTACHMENT TO PLANER.

power of man to line up a planed Willans-Bullock or Bullock-Willans engine bed exactly with the boring bar of a big boring machine. Those who have done such a job know whether it is easy to do or not, when the lining up must be nothing less than perfect. But if the shop has the big boring machine and the good man on it, there is still always a chance that something will fail, that there may be some minute error overlooked, and that the result will be faulty in spite of the best efforts of the workman. But if the bed can be clamped down on the planer table and first planed and then bored with a stationary boring bar, that is, with a boring tool which has rotatory motion only, then nothing less than an earthquake, which shall disturb the foundations of the planer ways between the time of planing and the time of boring, can prevent the boring and planing from being in exact agreement with each other. The idea is to put a short boring bar in horizontal bearings secured to a tool post saddle on the cross-rail and provide means for driving this bar, and then give the planer table a slow feed movement, and that is all there is to the thought.

The first objection, and about the only objection to the scheme, lies in the necessarily small diameter of the boring bar driving member, which must be less than the diameter of the hole to be bored in some cases. But it takes only a little power to drive one or two cutters with a slow feed in grey iron, and a spur gear smaller than the hole to be bored drives perfectly well. After the boring bar and the drive, comes the slow table feed, which has no hampering conditions, and can be had in any one of many very different and easy ways.

To give as complete an idea as possible of this unique device for converting a planer into a boring machine, five views are given. Fig 1 is a front view of the boring bar housing and drive which are bolted to the saddle on the planer cross-rail; Fig. 2 is an oblique view of the same, and Fig. 3 is a nearly full side view; Fig. 4 is a general view of the slow table feed parts, and Fig. 5 is an enlarged view of the feed parts which are partly supported on the large angle plate bolted to the shop floor, and partly by the large angle bracket bolted to the rear end of the planer bed.

In Figs. 1, 2, 3 the substantial cast-iron boring bar housing A is bolted to the swivel base of the tool post, the tool post block being removed. This bracket A extends forward far enough to carry the very short boring bar B, which is journaled in the underside of the bracket in sleeve bearings cast solid with the bracket. This shaft has a large flange on the outer end, and slips in place through the boring head and the driving pinion which make the collars for the boring bar B; the driving pinion collars the shaft on the rear side of the front journal; and the flange solid on the bar makes the front collar. As the bracket extends forward from the swivel base quite a distance it is braced by the angle strut C, from the front end of the bracket A, to a small bracket D, at the top end of the tool post slide E, where the strut C appears to have some kind of a screw length adjustment. The boring bar drive consists of a round belt driven shive J, which drives the worm shaft L; this worm shaft drives a worm gear, which is nowhere clearly shown, but which stands close to and directly behind the large spur gear M, which it drives, and



WORKING DRAWINGS OF BORING ATTACHMENT.

M gears directly with the pinion slipped on the boring bar. A T-shaped friction roller stand projects to the right from the mid-web of A, and carries long friction rolls to guide the round belt which drives the bar. The center of the bar stands a little below the planed underside of the bracket A, so that the boring bar can be let down low enough to bore a full half circle cut in the engine bed N, which has an oil catcher P, cast solid with it. As this whole rig is bolted to the tool slide of the saddle on the cross-rail it has, of course, all of the planer tool adjustments, and can be put in any desired place in reference to the work. The gear which gives the table its feed to carry the work along under the boring bar, is driven by a 3-cylinder Bullock drill engine, which

is a portable, in regular jobbing use about the shop wherever power is temporarily needed. This is cross-belted to a very neat worm and worm gear drive, arranged as follows: The change gear shaft driving pulley Q has its shaft journaled in a sleeve on top of the worm gear case, and on the end opposite the driving pulley, in front in Fig. 4, the first change gear of a set of "turn around" change gears is secured; this meshes with a second change gear on a shaft running in a sleeve cast on the underside of the worm gear case, and this under shaft carries the worm gear driving worm; this makes a very neat arrangement for a variable speed worm gear driver; the worm case is made symmetrical by having the worm sleeve below and the driving pulley shaft sleeve above, both cast in one piece with the main shell of the worm gear cover; the "turn around" change gears are of such diameters, of course, that any pair of them will fill the center to center distance between the pulley shaft and the worm shaft. These change gears may be made with any suitable common difference; if made in a set of six pieces of gear, a very common change set, the common difference may be 3 or 4 or 5 teeth, as is suitable for the extreme speeds desired; each piece of gear gives a change of speed, as any pair can be reversed. The worm gear is secured directly to the bed driving screw R, which works in a round nut S, which should be split in halves, and each half secured to one of the swinging jaws S, hung on pins between the downward opening jaws of the heavy grey iron bracket T, bolted fast to the planer table. The object of the open nut and swinging jaws is to release the nut from the screw, so that the planer table can be run by its own proper drive when it is desired to back up for a fresh boring cut. This worm gear screw drive was seemingly intended originally to be wholly supported by the heavy bracket U, bolted to the end of the planer bed; as I saw it working, however, a big planer angle plate had been bolted down to the floor, and to the upright of this angle plate the rear end of a screw supporting flanged sleeve was secured with a single strap and bolt W, Fig. 4. Probably the crooked bracket U, Fig. 4, did not prove stiff enough to take the thrust of the screw pulling the big planer table with a massive engine base on it. The feed for the cut itself would require very little power.

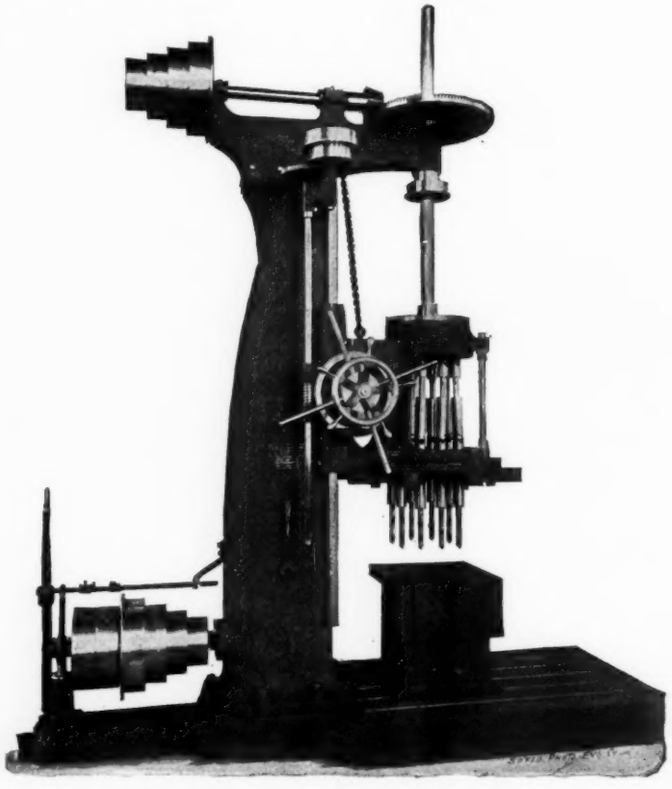
So far, this rig would not bore a full circle hole; but it is very easy to arrange the boring bar to project, say, 24 inches clear at the front end, and drop the boring bar a sufficient distance below the planer cross-rail so that in some patterns of frame work which are often seen, the several short bearings all in one line might be bored on the planer, full circle holes. In this case the boring bar fixture might have to be taken out of the way while moving from one bearing to the next, but all of this could be very easily arranged, and in this last suggested form the device seems capable of quite extended use. The device originated in the Bullock shops and has been only a few months in use. The tracing from which the saddle bracket and boring bar were constructed is reproduced in Fig. 6, and with the other engravings and the foregoing description will be readily understood.

HERMAN LANDRO.

An Eight-Spindle Multiple Drill.

We present herewith an engraving of an 8-spindle multiple drill built by C. H. Baush & Sons, of Holyoke, Mass. A good general idea of the proportion of the machine can be obtained from the engraving. This machine is designed to save a great amount of labor where a number of holes are to be drilled in one piece, such as cylinders, pipe flanges, valves, etc. Any number of 1-inch holes up to eight can be drilled in the time otherwise necessary for drilling one. The work to be drilled is placed stationary on the bed or table and the drills or spindles are fed by power. When holes have been drilled the spindles can be withdrawn with a quick return in connection with spindle head, which is counterbalanced by a weight inside the post. The machine is amply stiff enough for the severest work and can be quickly operated. The wearing parts are all large and all studs, worms, etc., are made of steel. One of the principle features of the machine is its being adapted to so large a range of work vertically, also that the spindles can be moved in any way and adapted to any layout within a 19-inch circle. For example, if eight or less holes are to be drilled in a straight line it can be done; if eight or less holes are to be drilled in any square or oval layout within a 19-inch circle it can also be done. Provision has also been made for changing length of spindles to suit different lengths of twist drills.

The following are a few dimensions of the 8-spindle machine: The total height of machine when the carriage is at its extreme height is 139 inches; size of bed, 116½ inches long, 36 inches wide, 7 inches thick. Greatest distance from end of spindles to bed 50 inches; greatest distance from face of upright post to center of circular carriage 20 inches; width of face on post 14½ inches; length of carriage on post 30 inches. Spindles fitted for Morse taper No. 3; traverse of head, 37 inches; the weight is about 8,000 lbs.



MULTIPLE SPINDLE DRILL PRESS.

Transporting a Heavy Fly Wheel.

Much interest has recently been manifested in the transportation of two large engine fly-wheels, built by the Southwark Foundry & Machine Co., of Philadelphia, for the Illinois Steel Co.'s plants at Chicago and Joliet, Ill. These are not the first wheels of this size and pattern which have been built by the above company.

These wheels are 25 feet in diameter, and weigh 180,000 pounds each.

Unlike most large wheels, they are not built up from a large number of sections, but are cast in halves weighing 90,000 pounds each.

The wheel rims are rectangular in section, 18 inches wide and 28 inches deep. Each wheel has ten elliptical arms cast solid with the rim and hub, the latter being 4 feet 3 inches diameter and 3 feet 4 inches long.

The hubs are bored to fit the engine shafts, 27½ inches diameter, and are secured to them by four 4x3-inch keys, spaced 90 degrees apart.

The two halves of each wheel are fastened together at hub and rim by means of bolts and shrunk links, four 4½-inch and four 5-inch bolts clamping the hub, and two links and one 5-inch bolt securing each rim joint.

The rims are provided with two rows of barring holes, 2x2x2 inches, spaced about 13½ inches apart, making 140 holes in each rim. The rows are staggered, which gives a barring distance for each hole of about 6¾ inches.

The wheels were made in connection with two 54x66-inch Porter-Allen engines, built by the same company, and which will be used for driving direct connected roll trains.

These engines will run under 110 pounds initial steam pressure, condensing, at 90 revolutions per minute, and under these conditions they will each develop, should emergency require it, over 5,000 horse power.

The photograph here reproduced was taken from one half of a wheel made for the Cambria Iron Co., Johnstown, Pa., which is an exact duplicate of those described above. It shows clearly the design of the wheels and the special trucks required to transport them, the latter necessarily being much stronger and lower than standard trucks.

A Factotum Bit.

We illustrate a bit that should be a valuable addition to the kit of a pattern-maker or general wood worker. It is claimed that it will do all work that the common bit will do, and it will certainly do a great variety of work that the common bits will not touch. The peculiarity of the bit consists chiefly in the fact that it dispenses entirely with any center pin or screw, and is held in place and guided by a sharp-edged ring of the full working diameter of the bit. Fig. 1 gives a general view of the bit. The spiral wire upon the shank is detachable, and is only used in boring deep holes to draw out the chips. Fig. 2 shows the bit in section and inverted. A flat cutter is inserted at the proper angle, which cuts and removes the material, leaving the bottom of the hole flat and without any central or other perforation beyond. Instead of the flat cutter others may be used, giving curved or other shapes for rosettes or fancy moldings, as shown in Fig. 3. Fig. 4 shows the bit with an additional cutter attached outside the ring, making larger circular moldings, as in Fig. 5. Fig. 6 is a depth gauge used in connection with the bit. Fig. 7 is a conical emery wheel for sharpening the rings. As the bit has no center, but holds to the wood by its outer edge, it can make portions of a circle as well as a whole circle. It will sink slots of any shape or do all kinds of panel or sunken work. It is good for inlaying circles, semi-circles, crescents, or any combinations of these figures, cutting out also the pieces to be inlaid. Fig. 8 exhibits some of the applications of this bit. It is made by A. L. Adams, Bridgeport, Conn.

Fig. 1.

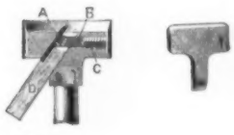


Fig. 2.

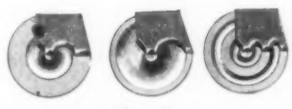


Fig. 3.

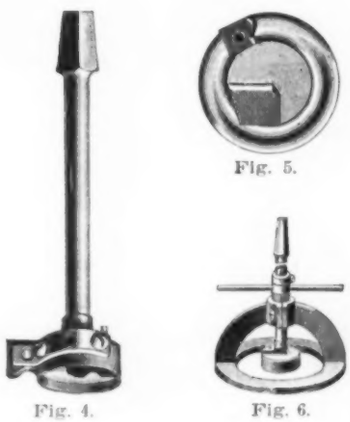


Fig. 4.

Fig. 5.

Fig. 6.

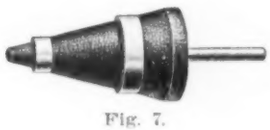


Fig. 7.

A FACTOTUM BIT.

An Important Steam Boiler Lawsu't.

The Abendroth & Root Mfg. Co., manufacturers of the Root water tube boiler, furnished boilers rating up to about 3,500 horse power, to the Philadelphia Edison Electric Light Co., between 1889 and 1891. In the use of the boilers trouble was experienced, and finally there was a fatal accident. A coroner's jury exonerated the makers of the boilers, and held the Electric Company responsible. Later the Edison Company brought suit against the Abendroth & Root Co. for $34,000, claiming bad workmanship, bad material and faulty design, and, as they had not paid all that was due on their orders for boilers, the makers brought counter suit for $6,830.99. Upon this suit a verdict was recently rendered in favor of the Abendroth & Root Co.

The trial brought out many points of great interest both to the makers and users of boilers. The plaintiffs showed that they had lived up to every article of their agreement, and had furnished the best material obtainable. In the use of the boilers the greatest trouble was in the breaking of bolts, and these bolts always snapped like pipe stems with not the slightest elongation or reduction of area. Many of the bolts were flattened cold under a steam hammer to less than ¼ inch in thickness, and the flattening was done without any sign of fracture running up into the body of the bolt. Many of the bolts were also tested by doubling cold until the ends met. Other bolts were made of the best rivet iron and substituted in place of the original bolts in the boiler, and they broke in precisely the same way, and steel bolts were also tried, with the same result. Three-quarter inch bolts were tried in place of the 5/8-inch bolts, but they fared no better. The shapes of the head and of the lug which received the head were changed, but they continued to break all the same.

Then the allegation of bad workmanship had to be met. Photos of the tools used in the manufacture of the boilers were exhibited, and the process of manipulation proved that bad workmanship was practically impossible in the case, and as similar troubles had not been experienced elsewhere, it was evidently due to local causes.

The Abendroth & Root Co. then proved that the accidents were due to the unreasonable handling of the boilers, with the object of forcing them beyond their rated capacity, sometimes as much as 100 per cent. It was shown that unskilled labor was employed, and that the men were instructed to keep the pressure up, irrespective of

A FACTOTUM BIT.

any demands that might be made on the boilers, the whole idea being to keep the lights going regardless of boiler capacity or the safety of the attendants.

Another point brought out, and acknowledged by the Edison Co., was the use of extremely bad feed water. It was taken from a well beneath the station. It was practically the surface drainage of Philadelphia. It contained sewage and ran thirty-four grains of impurities to the U. S. gallon, almost 8 per cent. being sulpnate of lime, with also salt and a number of nitrates and ammoniacal salts. To counteract the bad effects of the water, large quantities of chemicals were used, finally settling down to cutch, or what is more properly known as catechu, which contains much tannic acid. In a storage tank above the boilers large quantities of caustic soda were put in the water, making it so strong that water dripping from it took the hair off the backs of horses passing under, and seriously burning men who were sprinkled. The use of such feed water caused a large amount of scale in the tubes, varying from 5-16 inch to 1 inch in thickness, and reducing materially the tube area. The chemicals also attacked the metal of the boilers, oozing out and forming many incrustations, causing a rigidity of parts that were meant to be flexible, and also causing many tubes to burn out. An excessive forced draft, sometimes sustaining four inches of water, was also used to drive the boilers to the unreasonable extent to which they were forced.

Several experts appeared and accounted for the various troubles. Water hammer, however, and its consequences were clearly pointed out. Every pipe has a definite capacity of flow and discharge which cannot be exceeded, so that if a larger discharge is required, a larger tube must be used. In normal use the water and steam advanced easily up the inclined tube to the front headers, and thence up into the overhead steam and water drums. As the heat was applied in excess to the tube and more steam was generated than could be carried off by the proper channel, the accumulation and pressure of this steam in the tubes naturally forced a part of the steam and water backward and downward to the rear header, and here the steam suddenly found a chance to escape, and the colder feed and circulating water, trying to enter the lower ends of the tubes, came in contact with the steam thus seeking its escape, and the result was a sudden condensing of the steam and a rush of water into the vacuum at a high velocity, and this water rushed along the tubes until it reached a bend at the end; here it struck a blow like that of a cannon ball, and this blow caused the bolts to rupture, and so suddenly that any flaw of the metal in them was impossible.

It was remarked that it was fortunate that these boilers were composed of small headers, and that thus the damage done affected merely the bolts and the small castings, instead of rupturing large bodies of metal and large receptacles of steam and water, when the consequences would have been far more disastrous. Glass models were exhibited in the court, exhibiting beautifully the theory presented, and carrying conviction that the true theory was as here explained. Other glass models exhibited showed the power of the water hammer.

The plaintiff brought in, as an expert, Prof. Spangler, of Philadelphia, while the defendant brought in as experts, Dr. C. E. Emery, of New York, and Prof. R. C. Carpenter, of Sibley College, Cornell University. Prof. W. D. Marks, of the Philadelphia Edison Co., and Mr. Albert A. Cary, of the Abendroth & Root Mfg. Co., also testified as experts on their respective sides.

Universal Milling Machine.

We give herewith an illustration of a milling machine designed especially to meet the requirements of tool room work and of modern machine shop practice.

The column of the machine forms a cupboard, and the bearing standards are extended upwards and teed together by a sleeve through which the overhanging arm passes. The base of column has a raised edge all around it so that oil or other lubricant not previously caught is retained there and the floor kept clean. Spindle is of forged crucible steel, hollow throughout, and is threaded for chuck. Its taper hole is like that in the dividing head spindle, Brown & Sharpe taper No. 10.

The outboard bearing for the arbor is cylindrical and provided with an adjustable bronze bushing in the arm, the end, of the arbor being hardened and ground.

The Sellers' friction disks are used for feeding, and the feed is thus instantly changeable from .002 in. to .096 in. per revolution of spindle, or set at any intermediate rate. It is powerfully driven and tripped automatically in either direction or at any angle of table.

The spiral head can be revolved in a vertical plane through an arc of 210 degrees. It has a hollow spindle allowing pieces 1 1-16-inch diameter to pass through.

A full range of spirals, right and left hand, can be cut from one turn in 1 inch to one turn in 100 inches, by both simple and compound gearing. For every-day

practice, the range of simple geared spirals is amply sufficient, and the gears are as readily changed as on an ordinary screw-cutting lathe.

The foot stock is so arranged that large diameter cutters can be used on many jobs that would otherwise require small stem cutters.

Adjustment to take up wear is provided wherever lost motion would affect the accuracy of the machine.

The largest step of cone pulley is 12-inch diameter, for 3-inch belt. Vertical adjustment of knee, 19¾ inches; in and out movement of saddle, 7 inches; length of power feed, 24 inches; length of table, 36 inches. The machine swings on centers work 10½ inches diameter, 18 inches long, and weighs about 2,600 pounds. It is made by the Kempsmith Machine Tool Co., Milwaukee, Wis.

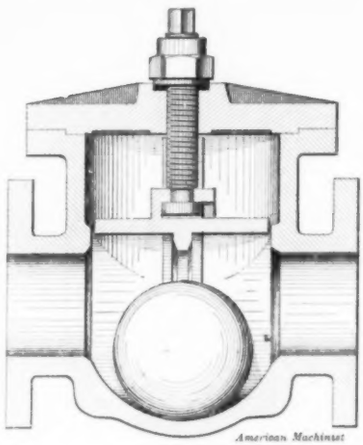


Fig. 1

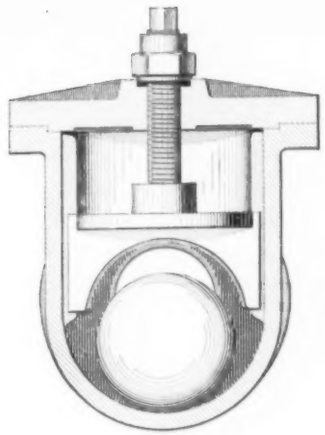
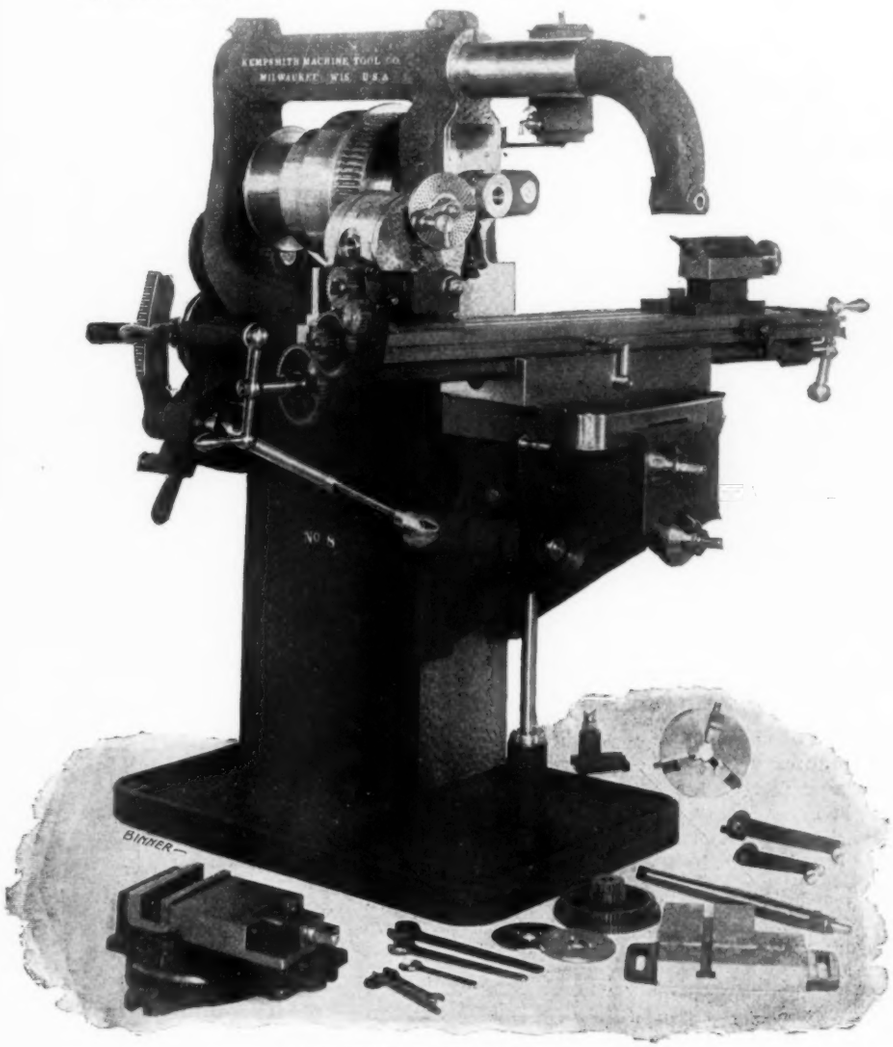


Fig. 2

SAFETY DEVICE FOR STEAM PIPES.



UNIVERSAL MILLING MACHINE.

A Safety Device for Main Steam Pipes.

A simple device which we illustrate has been brought out in England for use in steam pipes as a precaution against the escape of large quantities of steam in case a pipe bursts or is broken by any accident. It is usually not an explosion itself which does so much damage as the immense volume of steam and water which is poured forth. The valve shown is intended to automatically cut off the steam communication in case of such accident. The case contains a large loose ball which in the ordinary use of the pipe remains at the bottom of the casting. In case of a sudden reduction of pressure in either direction and an unusual rush of steam the ball will be swept along to the seat and will at once stop further escape. The sensitiveness of the valve depends upon the area of free passage past the ball, and an arrangement is provided for adjusting this area. A plate with a semicircular opening is arranged across the passage, and this is moved up and down and adjusted by the screw spindle shown. It seems to be necessary to place this valve in a horizontal position.

Experiments on Steam Pipe Explosions.

The following condensed account of a series of experiments, conducted by German engineers at the Royal Dockyard, Wilhelmshaven, will have special interest at the present time on acount of the frequency of steam pipe explosions. It was found that in most cases explosions take place while admitting steam into the pipe system (as in the recent case of the steamer St. Paul), and the supposition arose that possibly water contained in the pipes caused water hammer, and the series of investigations took their direction accordingly.

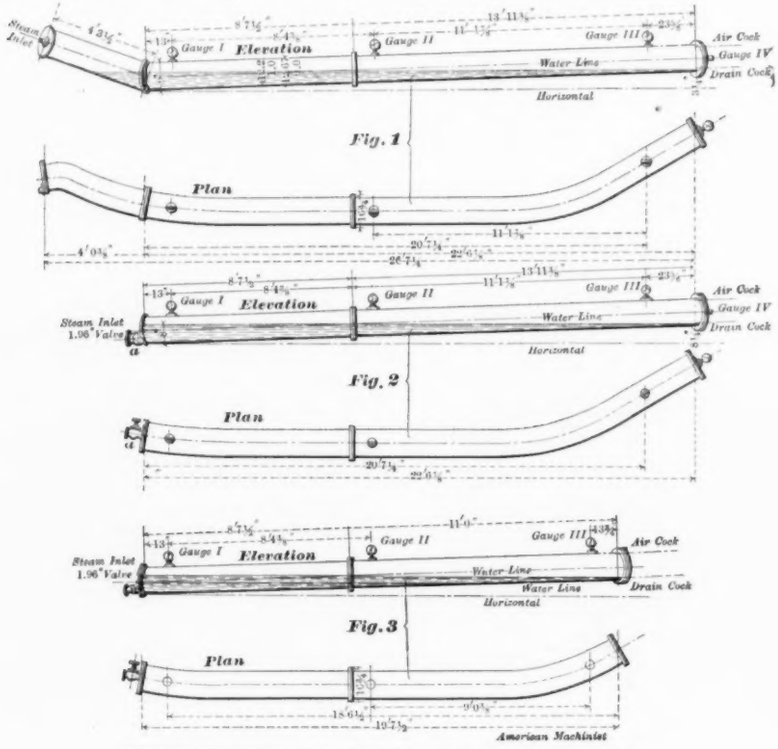
The first experimental pipe consisted of two equal lengths, bolted together, of 6-inch pipe, 3-16-inch thick, making a total length of 13 feet, and with the ends closed by flanges, one flange having a ¾-inch stop valve placed at the bottom, so that the steam would enter at the lowest point, and the other flange having a ½-inch drain cock at the bottom, an air cock at the top, and in the middle a gauge with a "maximum hand" registering to above 2,000 pounds. Later a second gauge was placed on the top of the pipe 23 inches from the steam inlet end. The stop valve was connected by a ¾-inch pipe with the shop boiler carrying 70 pounds. The large pipe was inclined upward, so that if

it contained any water the steam would have to pass through it.

The second experimental pipe is shown in plan and elevation in Fig. 1. It consisted of three pieces 12 inches diameter, and ¼ inch thick, with four pressure gauges, an air cock, and a ¾-inch drain cock. This was connected by a 3-inch pipe with the main steam pipe, with a valve near the main pipe.

The pipe was later changed, as shown in Fig. 2, the piece bent upward being removed and a 2-inch valve connected with the 3-inch pipe.

Fig. 3 shows a second change in this pipe. After the pipe had been burst near the flange opposite the steam inlet, and



EXPERIMENTS ON STEAM PIPE EXPLOSIONS.

two gauges destroyed, a new flange was brazed on and the blank flange bolted on minus the pressure gauge, and the gauge III was then placed near the flange on the side of the pipe.

The experiments were conducted according to a pre-arranged program, as follows:

1. Pipe without water, air cock closed, drain cock open.

2. Pipe without water, air cock open, drain cock closed.

3. Pipe without water, air and drain cocks open.

4. Pipe without water, air and drain cocks closed.

5. Vacuum in pipe and some cold condensed water, formed by creating vacuum, air and drain cocks closed.

6 Pipe filled with water to about one-third of its cubic capacity and vacuum in pipe, steam entering under water in first pipe, it being inclined toward that point. In the second pipe the water filled the pipe as indicated by the shaded surface. Air and drain cocks closed.

7. Pipe without vacuum filled with water, air and drain cocks closed.

8. Pipe without vacuum filled with water, air and drain cocks open.

The first pipe described was tried by adjusting the opening of the stop valve to one-fifth its area, and then admitting steam rapidly by the valve on the main pipe. In successive tests the opening in the stop valve was increased one-fifth of its area at a time.

In tests 1 to 4 no hammering or motion of pipes was observed whether the steam was admitted slow or fast.

In test 5, with a vacuum and a small amount of condensed water, light hammering occurred when steam was admitted; the gauges gave no indication, and only a slight movement of the pipe was in evidence. The hammering and swaying of the pipe increased with the quantity of water present, coming to distinct blows and at shorter intervals, and with gauge pressures from 128 to 242 pounds.

In test 6, it could not be determined that the vacuum had any influence on the action of the steam.

In test 8 the heaviest hammering and greatest movement, long continued, occurred with the pipe one-third full of water and with air and drain cocks open.

With one-fifth opening hammering was noticed in 4 minutes, with three-fifths opening in 30 seconds, and with full opening in 15 seconds, powerful hammering and violent motion of the pipe, with impulsive discharge of water and air, and later of steam, from the drain cocks. The pressure at the end of these trials fluctuated between 284 and 1,066 pounds. The greatest pressure would show sometimes on one gauge and sometimes on the other.

The second pipe, Fig. 1, was then tried according to the program, first to show the action of steam in bent piping of large diameter. Steam from the 3-inch supply pipe was admitted to the turned up end. With the pipe empty, with or without vacuum, the same observations were made as before. When the pipe was one-third full of water the action of the steam was quite different from that before observed; only single and insignificant blows occurred. In opening the stop valve slowly the maximum gauge pressures were the same as the boiler pressure, but with the steam admitted suddenly the maximum pressures on the four gauges were respectively 426, 113, 199, 113 pounds. The drain cocks were open.

The pipe was then changed as shown in Fig. 2. With this arrangement the same general results were obtained throughout the entire series of tests as with the first pipe, the intensity of the hammering, however, in some cases causing accidents, breaking new, heavy ropes that held the pipe. With the pipe full of water and the stop valve three-fifths open, air and drain cocks open, the threads on four nuts holding the end flange were sheared off, the flange bent, the gauge in it destroyed, and the pipe bulged. The pressures on the three gauges were I, 483 pounds; II, 384 pounds, and III, 924 pounds.

On another trial, with three-fifths opening, after 65 seconds the pipe burst 4 inches from the end flange and 8¼ inches long. The gauge pressures were 313, 185, 853, and on the gauge in the flange it was above the limit of the gauge, 2,000 pounds.

With the pipe as in Fig. 3, the observations were again as in the first pipe. The water was then gradually lowered to the line shown in the figure, 6 inches deep at the steam inlet, to learn at what level the violent hammering takes place, and it nearly ceased at the level indicated, 6 inches. At 6.69 inches, however, the hammering was still so violent that the maximum pressures were: I, 853; II, 497; III, 853, and on a later trial they were: I, 569; II, 498, and the screw tap on gauge III was torn off.

Upon increasing the original water level of 9 inches to 9.84 two bolts in the flange were broken, and the pipe was ruptured in two places.

In none of the tests could the water be entirely ejected, even after a long period.

Some important deductions are made from these tests. Destruction of a completely drained pipe cannot occur, even if entirely cool, and whether the admission is slow or rapid. A rapid filling may be disastrous on account of the sudden and unequal heating and straining of the pipe.

When a large quantity of water is contained in the pipes, and the steam must

get through it or carry it along, an explosion may occur even if the valve is opened in the slowest and most cautious manner.

If there is so little water in the pipe that steam need not force its way through it no disastrous hammering will occur and the water present will not be carried along by the steam.

Where water has accumulated in U bends of pipes, if the valve is opened gradually the entering steam will distribute itself at once over the surface and will prevent any agitation of the water and hammering. If, however, a sudden change of pressure and a rapid influx of steam occur, then the water will be agitated, and once in motion will cause violent and dangerous hammering, so that pockets in steam pipes are to be avoided.

The water seems to be thrown backward and forward with a wavelike motion, caused by the influx of steam, and the pressure is greater or less, depending on the intensity with which the moving mass of water strikes the opening to which the gauge is attached.

Each test mentioned in the paper was repeated several times, so that no conclusions are based upon isolated experiments. The various dimensions given are only approximate, as the original measures were metrical.

Experiments on the Friction of Screws.*

BY ALBERT KINGSBURY, DURHAM, N. H.

Within the past three years the writer has made several hundred experiments on the friction of metallic screw-threads under the conditions of very slow motion, free lubrication, and pressures varying from zero to 14,000 pounds per square inch of bearing surface.

The results sought were the minimum and the mean coefficients of friction under these conditions. No attempt was made to find a maximum coefficient; this would require trials without lubricants and with rough surfaces. The maxima obtained under the given conditions were noted, however.

The tests were made upon a set of square-threaded screws and nuts of the following dimensions:

	Inch.
Outside diameter of screw	1.426
Inside diameter of nut	1.278
"Mean diameter" of thread	1.352
Pitch of thread	$\frac{1}{5}$
Depth of nut	$1\frac{1}{16}$ (effective)

This depth of nut makes the area of thread approximately one square inch, so that the total axial load on the screw is also the pressure per square inch on the thread surface.

The nuts fit the screws very closely, so that all friction is excluded, except that on the faces of the threads directly supporting the load. The threads were cut carefully in the lathe, and had been worn to good condition by trials previous to those here recorded. Screw No. 5 was not quite so smooth as the others.

The machine used for the experiments was designed for the purpose. It was built in the New Hampshire college shops in 1891-92, and now forms part of the laboratory equipment of the college. It is used by students for experiments similar to these; also for testing materials in torsion and in compression. The only changes involved in its several uses are in the loose jaws receiving the test pieces. The machine is shown in front view in Fig. 1, in which the pendulum is swung forward about 45 degrees, and in section (upper part only) in Fig. 2.

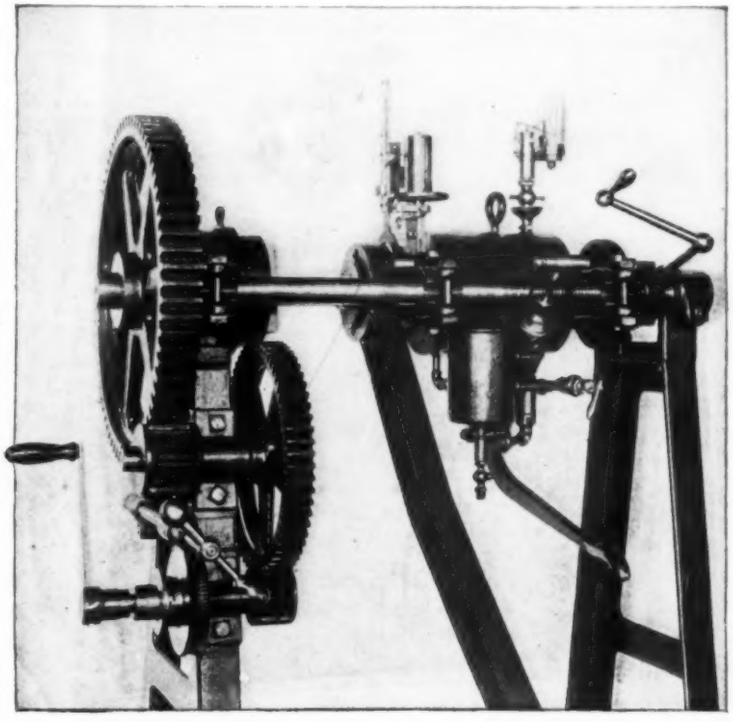


Fig. 1.

SCREW-TESTING MACHINE.

The construction of the machine is clearly shown in the section. The gearing at the left serves to turn the test screw, the thrust being received by the ball bearing. The nut is carried by the pendulum, coaxial with its hardened steel spindle, which turns and moves endwise freely in its ball bearing. The moment required to turn the nut is indicated by the amount by which the pendulum swings out from the vertical as the screw is turned. The thrust of the nut is transmitted through the spindle of the pendulum to the trunk piston in the heavy cylinder, the oil confined behind the piston forming a frictionless thrust bearing, upon which the piston turns with the spindle, while the rise of the pencil of the indicator shows the total pressure on the piston, which is the load on the screw. (In the section the piston is at the extreme right of its $\frac{7}{8}$ inch motion.) The piston is close fitting, without packing of any kind, and its motion is practically frictionless at slow speeds. Thus the swing of the pendulum is that due to the action at the threads of the test screw, and that only to a reasonable degree of exactness.

The thrust is ultimately taken up by tension in the long side bolts passing through the front and rear crossheads. The cylinder, with its attached parts, slides along these bolts to adjust for different lengths of test pieces, the motion being obtained by means of the geared nuts back of the rear crosshead.

An autographic record of each test is obtained by means of the indicator. As the screw is turned, setting up pressure in the oil in the cylinder, the pencil rises an amount proportional to the pressure. At the same time, as the pendulum swings out, a pin at its back lifts the slider above it a distance proportional to the moment of the pendulum, and by the wire this motion is transmitted to the drum of the indicator. Thus any point on the line traced by the pencil indicates, by its ordinate, the pressure on the screw, and by its abscissa the moment required to turn the nut under that load. The hand pump serves to replace the oil from the front to the back side of the piston, past which the oil gradually leaks under pressure. When the machine is used for simple compression tests, the pump is used to apply the pressure.

* Presented at the New York meeting (December, 1895) of the American Society of Mechanical Engineers.

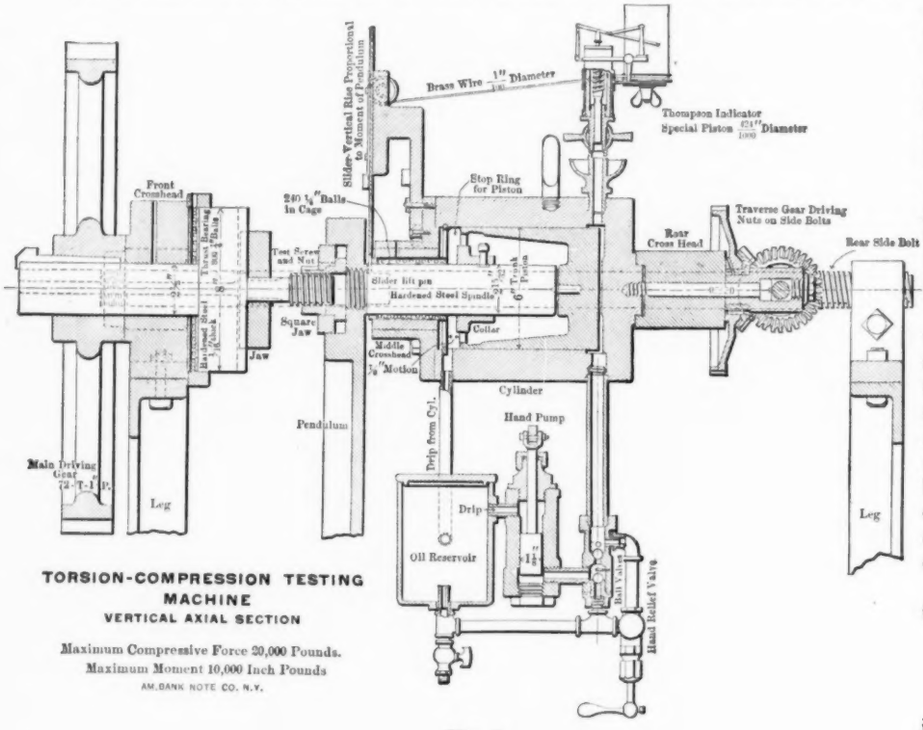
The screws and nuts used in the test were as follows:

No.	Material.
	SCREWS.
1	Mild steel.
2	Common wrought iron.
3	Cast iron.
4	Cast bronze.
5	Mild steel--Case-hardened.
	NUTS.
6	Mild steel.
7	Common wrought iron.
8	Cast iron.
9	Cast brass.

Four sets of tests were made, with lubricants and pressures as follows:

No. of Set.	Lubricant.	Maximum Load.
		lbs.
1	Heavy Machinery Oil	14,000
2	Winter Lard Oil	14,000
3	Heavy Machinery Oil and Graphite, in equal volumes	14,000
4	Heavy Machinery Oil	4,000

The "Heavy Machinery Oil" was a purely mineral oil of specific gravity .912.



TORSION-COMPRESSION TESTING MACHINE

VERTICAL AXIAL SECTION

Maximum Compressive Force 20,000 Pounds.
Maximum Moment 10,000 Inch Pounds

AM. BANK NOTE CO. N.Y.

Fig. 2.

The "Winter Lard Oil" had a specific gravity of .919.

In each set of tests, screw No. 1 was tested with nuts Nos. 6, 7, 8 and 9, successively; then screw No. 2, with the same nuts, in the same order, and so on. In the first set eight cards were taken from each pair, but as the mean of the first four cards taken throughout was identical with the mean of all, it was considered that four cards each would suffice in the remaining sets. Set No. 3 is a duplicate of a previous set, with the exception that the pressure was carried to 8,000 or 10,000 pounds only in the first trial, while in the second (the one tabulated), the pressure was carried to 14,000 pounds. The mean results of the two sets were practically identical. The screws and nuts were flooded with oil when placed in the machine; the four or eight cards were then taken without re-oiling, except as the oil was redistributed each time the pressure was relieved, and when taken out, both screw and nut were thoroughly cleaned in dry sawdust before interchanging, except in set 3, in which they were not cleaned.

The method of testing was as follows: The test pieces being placed in the machine, the gearing was turned by hand, driving the screw at a very slow rate (not more than one revolution in two minutes), until the pressure was raised to the desired amount, the pendulum meanwhile being swung out by the moment required to turn the nut. The relative motion of screw and nut during this time was very slight, being only that due to spring of parts of the machine, and the slight displacement of oil in the cylinder, so that the action between screw and nut was quite similar to that taking place in ordinary machine bolts when tightened upon comparatively unyielding material. The motion was usually rather irregular, the screw and nut being relatively at rest from ten to twenty times during the tightening, as is well shown by the cards. This was partly due to the jar of the gearing.

When the maximum pressure was reached, the gearing was locked, and the hand relief valve was opened slightly; as the pressure fell the pendulum slowly descended, turning the nut on the screw in the same relative direction as before, but reversing all the motions of the machine which, by their friction, might affect the card. Thus, if the piston did not turn freely, it would make the "up" line on the card too high, and the "down" line too low; and for friction in the indicator piston and other parts there would be corresponding deviations in the lines. But in most tests the "up" and the "down" lines coincided very closely, showing either almost total absence of friction, or compensation of the errors. In those cards in which the lines did not sensibly coincide, the true card was assumed to lie midway, as this would give the proper mean, whether the deviations were due to friction in the machine or to change of the co-efficient at the screw. Usually the "down" line was the smoother, the jar of the gears being absent.

The general form of the cards is that of a curve closely approximating a straight line, with small irregularities throughout, as shown in Fig. 3. The curvature is usually in the direction indicating a smaller co-efficient at higher pressures; a straight line card would indicate a constant co-efficient, or "friction proportional to pressure."

The co-efficients given in the first three tables were taken at 10,000 pounds load on the screw. The fourth set was made with much lighter indicator spring and pendulum, to get a large card at low pressures. As the average result of this set, read at 3,000 pounds, was practically identical with that of the first set, read at 10,000 pounds, it was assumed that each card might be considered as a "straight line" card.

The labor of computation from the cards was reduced to a minimum by plotting on a piece of transparent celluloid a series of straight line cards with a common origin, and for co-efficients varying by .02 from .04 to .24, and involving all corrections shown to be necessary by a careful calibration of all parts of the machine and indicator. The celluloid sheet being placed over the actual card, the proper average co-efficient for that card could be read off.

The computations were based upon the formula

$$Q = P\frac{\frac{p}{2} + \mu\,\pi d}{\pi d - \mu\, p}$$

in which

Q = tangential force necessary to turn the nut, applied at the mean radius of the thread.
P = total axial load.
p = pitch of thread.
d = mean diameter of thread.
μ = coefficient of friction.

The comparatively low co-efficients frequently obtained in set No. 3 were also made evident by the "overhauling" of the screw when pressure was applied by the hand-pump—the highest co-efficient at which this can occur being about .076 for these screws. The graphite and oil were well distributed between the nut and the

screw, the looseness of the fit making this possible.

[Several tables embraced in the paper we are under the necessity of omitting for lack of space.—Ed.]

The conclusions which the results seem to warrant are:

That for metallic screws in good condition, turning at extremely slow speeds, under any pressure up to 14,000 pounds per square inch of bearing surface, and freely lubricated before application of the pressure, the following co-efficients of friction may be used:

COEFFICIENTS OF FRICTION.

Lubricant.	Minimum.	Maximum.	Mean.
Lard oil.....	.09	.25	.11
Heavy machinery oil (mineral)....	.11	.19	.143
Heavy machinery oil and graphite, in equal volumes	.03	.15	.07

The writer does not consider that the tests prove that any one of the metals used develops less friction than any of the others, under the methods of testing employed, although such results might be inferred from Table III., for instance, in which the co-efficients for the brass nut are uniformly lower than for any of the others. Nor does he believe that the method of testing employed is the best possible; a number of cast-iron nuts and screws tested by themselves, and a number of steel nuts and screws similarly tested, might give results showing less variation than is evident in the records given above, and hence more definitely comparable with each other.

Addendum—In using the machine for testing materials in torsion, a graduated arc and a pointer are attached directly to the 10-inch test piece at points eight inches apart. The two-inch drum above the head of the pendulum (shown in the photograph only) is used for obtaining "semi-autographic" records. For equal intervals in the angle of torsion, as read on the graduated arc, the drum is turned by hand a fixed number of teeth on its ratchet wheel, while the pencil, carried on an arm of the slider, rises a distance proportional to the moment of the pendulum. The record thus obtained gives virtually a number of points in the true card, from which both strain and stress may be scaled; or the strain may be referred directly back to the graduations on the arc. After the stress has been carried sufficiently beyond the elastic limit, the rotation of the drum is discontinued, and the maximum moment is autographically recorded by the vertical rise of the pencil. The angle of torsion at rupture is determined, in ductile materials, from the fractured specimen, marks being made for the purpose before testing. With brittle materials, the angle of torsion at rupture may best be determined from the initial and final positions of the heads carrying the jaws, the reading arc and pointer being removed before fracture. The cards obtained as above are on a large scale to a point somewhat beyond the elastic limit; the maximum stress is determined accurately, and the maximum strain is determined with sufficient accuracy for any practical purpose.

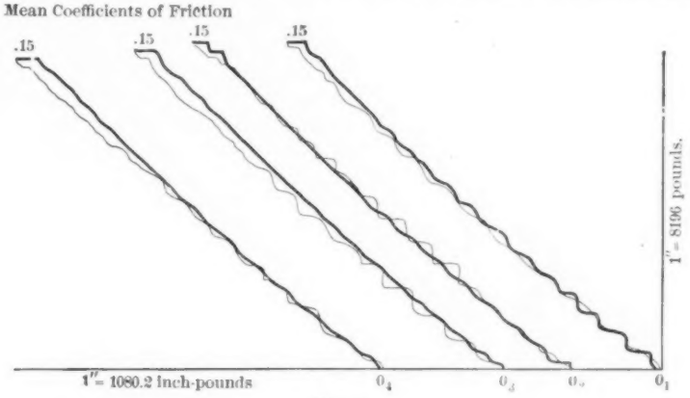


Fig. 3.

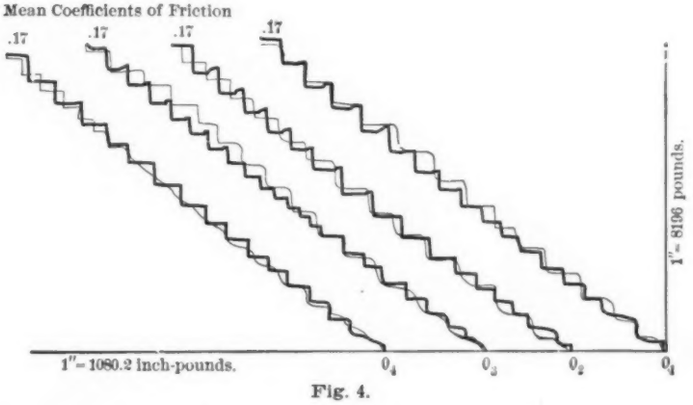


Fig. 4.

On the 21st of December Mr. William Lodge, of Cincinnati, O., sold his interest in the Lodge-Davis Machine Tool Co., of that city, to Messrs. Chas. Davis, Thomas P. Egan, Robert Laidlaw and Thomas McDougall. The purchase represents $240,000 worth of stock, and terminates a long and bitterly-contested legal controversy. The new officers of the Lodge-Davis Machine Tool Co. will be: Charles Davis, president; W. H. Burtner, vice-president and treasurer, and B. B. Quillen, secretary. This brings into close relationship the Lodge-Davis Machine Tool Co., the J. A. Fay & Egan Co., and the Laidlaw-Dun-Gordon Co., and may lead to the consolidation of their various stores in the principal cities of the country.

Mr. Wm. Lodge will devote his entire attention to the affairs of the Lodge-Shipley Machine Tool Co., which concern is now exceptionally busy, and is running its plant until 10 P. M. every night.

Oil on Reamers and Taps.

Editor American Machinist:

Being a constant reader of your valuable paper, and a machinist for fifteen years, I desire to present this subject for the consideration of mechanics who are or have been engaged in working the metals. I hope some of the readers of this paper will be kind enough to give me the benefit of their experience upon this subject. When reaming a hole in cast iron with a hand reamer, is it advisable to use oil of a good quality (pure lard oil), or is it better to use the reamer dry? Which is most disastrous to the reamer?

Also let us have a word about the use of oil on taps in cast iron. It is my purpose for the present to get the experience of practical men upon these questions, after which I will have more to say. H. E. S.

Pittsfield, Mass, Dec. 20, 1895.

The Car Building Industry.

The "Railroad Gazette," in its issue of Dec. 27th, says: "Reports from the car building companies show that car building also has taken an upward turn, the output of the contracting shops being 31,893 freight cars. This is in comparison with 17,029 freight cars built in 1894. When we say that car building has taken an upward turn, we limit the phrase to a comparison with the previous year. The total of cars built this year is not a large record by any means, and makes the number built in the years immediately preceding (51,000 in 1893 and 93,000 in 1892) appear extraordinarily large. It seems probable that railroad managers have continued the use of much equipment, not in good condition, and which ordinarily would be replaced. In this fact lies the hope of the car builders."

ELECTRICAL MACHINERY.

Electrotechnics—I.

The Principles of Electricity for Practical Men.

BY FRANK S. MASON.

1. ELECTROTECHNICS, the science of the methods, processes and operations in which electricity is applied in the industrial arts. Standard Dictionary, 1895.

2. ELECTRO-MAGNETICS, that branch of physics which treats of the relations between electricity and magnetism and of the phenomena due to those relations. Id.

3. THE SCOPE of these notes is indicated in the above definitions. It is the intention of the writer to disclose as briefly and compactly as is consistent with clearness the principles which underlie the modern commercial employment of electricity in transportation, the transmission of intelligence, and the diffusion of light, power and heat. And in particular to explicate the application of those principles to the constructive design of the electro-magnetic machinery which has been the principal factor of commercial success.

To this end facts will be presented in preference to hypotheses. Results will be exhibited without discussion as to

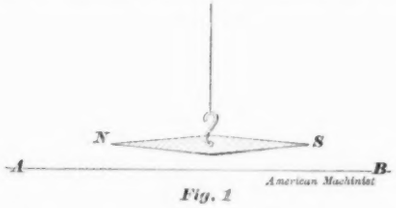


Fig. 1

primal causes. Although the electric current as such is denied (and even the existence of electricity doubted) by ultra scientists, yet, as the term conveniently expresses many phenomena and is in common use, it will appear in the following matter, together with such other terms and misnomers as are associated with the subject. There will be no straining for effect or distortion of language. Electricity and its varied manifestations are sufficiently wonderful without exaggeration. As wonderful, indeed, as heat, light or a blade of grass.

Nevertheless, the study of electricity is not to be approached with fear and trembling. The mind should be divested of the notion that it is a difficult subject to master. Like all other human knowledge, it requires only persistent application. Unfortunately, the electrical profession, because it affords an opportunity to indulge in the mysterious, attracts charlatans and persons much given to wind, and a relatively simple matter is befogged to such a degree that we who are common clay are a bit afraid of the subject. The strange terms and arrays of mathematics in electrical publications appear most formidable. Once familiar with the meaning of the terms they are as simple as gravitation or revolution per minute; and as the writer is a stranger to mathematics these notes will not include that stumbling block.

All students are obstructed by a failing common to all instructors, viz., giving

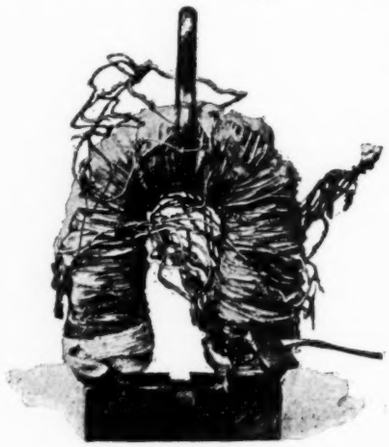


Fig. 2.

lessons in spelling before teaching the alphabet. On the other hand, students are impatient of words of one syllable and prone to skip. During nine years as instructor in evening drawing schools the writer's greatest difficulty was to avoid slurring points as familiar to him as a b c, but a foreign language to his pupils. And his greatest obstacle was the difficulty of obtaining an expression of understanding from his class whereby he might govern his progress. It is desired that each reader of these notes will demand an explanation of obscure points, thus assisting himself, his instructor and his fellow students.

4. HISTORICAL. In 1819 Oersted demonstrated the relationship, if not the identity of electricity and magnetism. Oersted's experiment is illustrated in Fig. 1, in which, if an electric current flow from A to B through a conductor, the north pole of the magnetic needle will be deflected toward the west. If the current is reversed the deflection will be to the east. If the conductor is placed above the magnetic needle contrary results will ensue.

In 1820 Arago and Davy each discovered that a steel bar could be magnetized by an electric current. In 1825 Sturgeon applied this discovery to the invention of the electro-magnet and coined the name therefor. As early electro-magnet is shown in Fig. 2. In 1827 Ohm promulgated his law of the electric current, viz., the current varies directly as the electromotive force and inversely as the resistance of the circuit. In 1831 Faraday discovered that an electric current could be generated mechanically by the mutual action of a magnet (either permanent or electro) and a conductor, which discovery is illustrated in Fig. 3, in which plunging the coil A into the coil B induces a current in the conductor C C. Withdrawing it induces a current in the opposite direction. D is a battery and E a galvanometer. Following this discovery Faraday constructed a continuous current dynamo illustrated in Fig. 4, in which S N is a permanent magnet, D a revolving copper disk. It was afterward discovered that an iron disk gave better results. This machine has never been adapted to practical service, since the current generated is very large in volume and low in pressure. Faraday also discovered the induction coil, also termed the transformer or converter, shown in Fig. 5, where P is the primary coil, S the secondary coil, R an iron ring. An intermittent direct current, or an alternating current, through the primary coil causes fluctuations in the magnetic field, which fluctuations induce an alternating current in the secondary coil. Previously, in 1821, Faraday had accomplished electro-magnetic rotation, foreshadowing the electric motor as in Fig. 6, in which N S is a permanent magnet, M a pool of mercury, into which the wire W dips. When a current is sent through the conductor C, the wire and the mercury, the wire circles about the magnet, pursuing itself. Later, in 1831, Dal Ne-

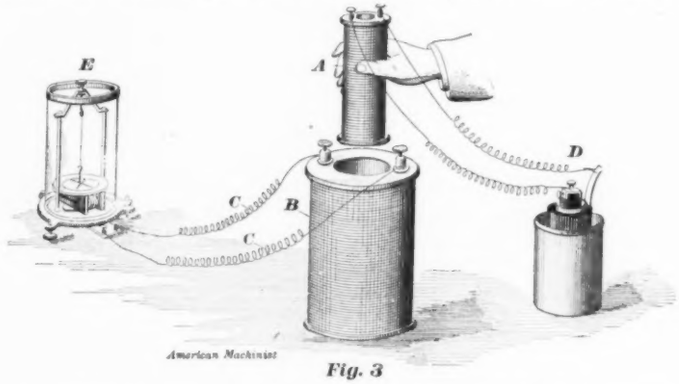


Fig. 3

gro produced an alternate current oscillator (à la Tesla), and Pixii a rotating alternate current dynamo. In 1832 Ampere invented the commutator. Thus were the foundations laid and science waited on commerce. The scientist had done his work, and some fifty years later the business man awoke to the fact.

From 1832 until 1888 improvements in detail only are to be noted. It came gradually to be understood that any dynamo or motor could be made to reverse its

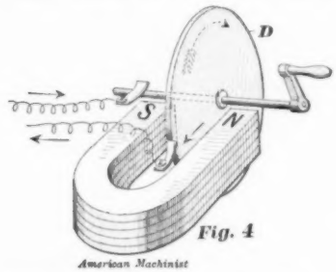


Fig. 4
American Machinist

function; that the electro-magnet was far superior to the permanent magnet for dynamo electric machinery, and that a dynamo could be made self-exciting by sending the current generated in the armature through the field magnet.

In 1888 Professor Sylvanus P. Thompson, by far the most able English writer and authority on electrical subjects, assembled the researches of Rowland, Hopkinson and Kapp, and promulgated the law of the magnetic circuit, viz., the magnetic flux is equal to the magneto motive force divided by the reluctance, a parallel

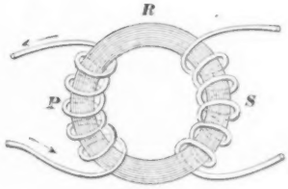


Fig. 5
American Machinist

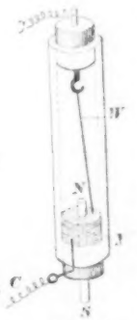


Fig. 6
American Machinist

law to that of Ohm on the electric current. This law, in conjunction with Ohm's law, placed the design of electro-magnet machinery upon a secure mathematical basis. Previous to this date the designing of a dynamo or motor had been a matter of empiricism.

5. UNITS. Curious names are often given to principles supposed to be newly discovered, but which in reality are old and have proper technical names. One vagary of scientists has been the giving of individual names to physical conceptions which have technical names when those principles are properly understood. This annoyance exists more in the electrical profession than in any other branch of science, the result of which is sometimes ridiculous. The Electrical Congress, which met in Paris in 1881, occupied much time in discussing which individual names should be adopted for electrical conceptions. Many superficial writers and talkers have much bothered earnest students by this form of solemn nonsense—Nystrom.

Any system of physical units must include three fundamentals, viz., length, mass and time, from which all others are derived. The most commonly accepted dimensions for these fundamentals are the centimeter (about four-tenths of an inch) for length, the gram (equal to a cubic centimeter of water at 4 degrees C., or about fifteen and one-half grains) for mass, and the second for time. These constitute the so-called C. G. S. system.

There are some thirty odd electrical units based on this system, of which eight are the so-called practical units, including:

The volt or unit of electro-motive force.
The ohm or unit of resistance.
The ampere or unit of current.
The watt or unit of power.
The joule or unit of work.
The coulomb or unit of quantity.
The farad or unit of capacity.
The henry or unit of induction.

Since quantities many times as large or small as some of these must often be expressed prefixes are used for the sake of brevity. Thus mega indicates one million as "megohm" or one million ohms; micro means one millionth part as "microfarad" or one millionth part of a farad. In like manner kilo indicates one thousand, and milli one thousandth part, as kilowatt and milliampere.

Houston's electrical dictionary defines a volt as, "Such an electromotive force as will cause a current of one ampere to flow against a resistance of one ohm;" an ohm as, "Such a resistance as would limit the flow of electricity under an electromotive force of one volt to one ampere;" an ampere as "Such a current (or rate of flow or transmission of electricity) as would pass with an electro-motive force of one volt through a circuit whose resistance is one ohm;" and a watt as "The voltampere or unit of electric work." This latter is incorrect, since a watt is the unit of power, which is quite a different thing from work.

The above discussion is chiefly preliminary and introductory. Next week I hope to enlarge upon the real nature and the relationship of the electrical units in a manner which will be intelligible to all.

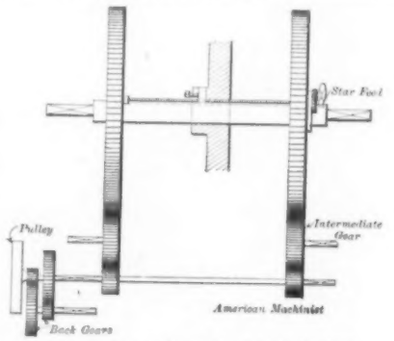
Too many electricians—electrical engineers and electrical editors alike—seem to proceed upon the idea that if electricity offers a means of doing a piece of work it therefore offers the best means.

Our attention was recently called to a case of a factory proprietor in Connecticut who had applied an electric motor to a special case in his workshop with decided advantage—so much so that he at once conceived the idea of driving his entire plant with motors, and proceeded to take advice in the matter from those who should have been able to give it. With a single exception his advisers assured him that the proposed application was a legitimate one, from which he would reap many advantages. The exception (who, to his still greater credit, was a manufacturer, and directly interested in making sales) was a gentleman whose mental vision had not been blinded by the brilliancy of electrical achievement. He saw, on investigation, that the conditions were such that the various machines were very compactly arranged, and the running of them was practically continuous. In other words, the amount of idle shafting and belting to be eliminated by electrical transmission was small, and as the actual power consumed by the machines could not be changed, electrical transmission could save nothing, and the proprietor was so advised.

The incident illustrates at once both the proper and improper method of trying to advance electrical interests—the latter of which, we are sorry to say, has been altogether too common.

A Dynamo Field Boring Machine.

In the construction of multipolar dynamos, the interior ends of the field magnets require to be bored to a true circle. Until comparatively recently it has been feasible to do this work on a horizontal boring mill. The growth of the direct connected



GEAR OF BORING MACHINE.

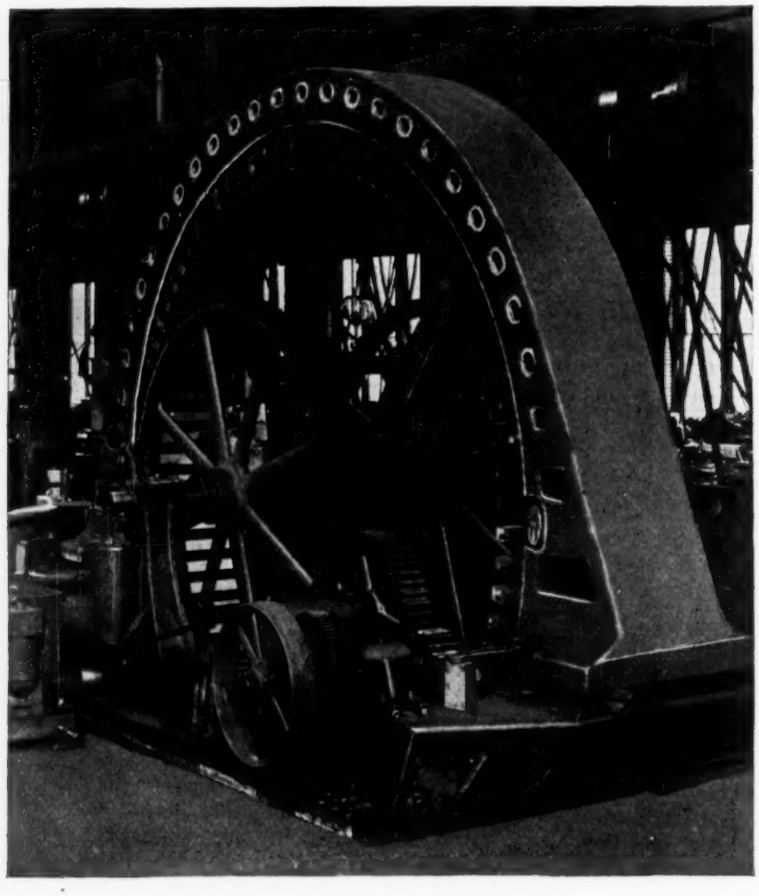
dynamo, and especially the use of that construction in connection with large and moderate speed engines have, however, led to work of dimensions beyond the capacity of the boring mill to handle, since, of course, any decrease in rotative speed of the armature leads at once to a corresponding increase in its diameter. With directly connected armatures mounted on Corliss engine shafts, the diameter thus becomes very considerable.

The accompanying illustrations show a special machine for performing this operation on the largest size generators. The magnet frame of such a generator is shown in position, with the pole pieces being bored. The operation is almost self-explanatory, but it may be remarked that the feed is accomplished by moving the cutter bar bodily lengthwise of the main shaft

by means of a screw and the usual star feed. The cutter bar is double-ended, and its ends are removable—the length of the end pieces used being determined by the diameter of the work being done. The machine is driven by an electric motor, as clearly shown. The driving of the cutter bar is by means of two bars parallel with the main shaft, these bars being driven from both ends by the two large gears, thereby securing a stiff cut with little vibration. The connection between the driving power and the large gears is shown in the smaller illustration.

The machine is the design of Mr. John Riddell, supervisor of machinery and tools at the works of the General Electric Co., Schenectady, N. Y. We are indebted to the General Electric Co. for a photograph and drawing of the machine from which the accompanying engravings were made. It is but proper to add that the machine is covered by patents.

In the generator shown as under construction, the field magnets are cast in place in the magnet frame. In other constructions the magnets are less numerous than in the illustration, and are bolted to pads or faces on the inner surface of the magnet frame. On large machines and with the usual tools, the planing of these pads is obviously an awkward piece of work. We expect shortly to illustrate and describe a special machine employed at the works of the General Electric Co. for performing this operation.



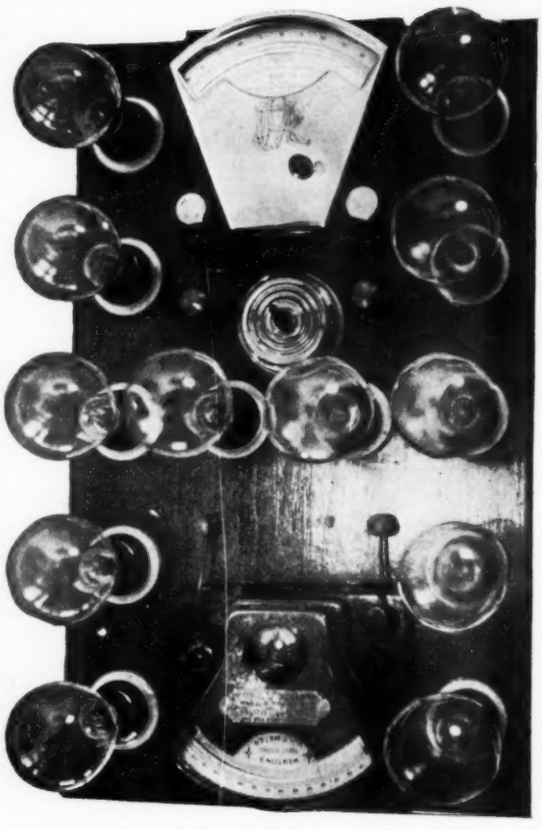
FIELD BORING MACHINE.

Simple Appliances for Accurately Testing Incandescent Electric Lamps.

BY PETER H. BULLOCK.

During the past year, owing to expiring patents, decisions of courts and improved processes of manufacture, there have been put upon the market numerous makes of lamps that are usually accompanied by literature, which, if correct, would prove each lamp to be as good as the best, not only in the maximum amount of light and length of life, but also in the minimum amount of energy required for its operation.

The affable salesman will call with samples, ask your voltage, and attach one of his lamps, which he will assure you is right out of the barrel, and not a show lamp at all. Of course, his lamp



TESTING BOARD. Fig. 1.

is new and clean, and as the one he removes may be old and the globe discolored, the superiority of his lamp is too evident to require further proof in that direction, and the data of the circular give all other needed information as to life, efficiency, etc., etc. He will probably quote you a price of 22 cents for barrel lots. You will buy, and pat yourself on the back for getting a better lamp than you paid 36 cents for a year ago. It is true that a hat is a hat, but it is just as true that there is a great difference in the quality of head gear. There is also as great a difference in the quality of lamps, and it will be the object of this paper to show how any one can test his own and determine their actual efficiency.

A very material increase in the reading of the ampere meters, the power required to drive the dynamos and the fuel consumed, after about a year's operation of a plant, convinced me that there was either a great loss of energy in the old lamps or else that some of the new kinds being tried were consuming far more power than the amount of light being produced justified, and in order to settle these questions the simple appliances below described have been constructed and valuable positive information secured.

To ascertain just the amount of energy required to operate any make or style of lamp to be tested, the board shown in Fig. 1 was constructed. It is 24 x 20 inches, with receptacles for twelve lamps, and binding posts for the feed wires and

the volt and ampere meters. The board is made double, with the writing concealed in grooves between the pieces. As will be seen, it is possible to accurately measure the energy required to light the whole twelve, or any less number. As the accepted electrical horse power is 746 watts, it will be seen that the capacity of the board in 16 c. p. lamps is equal to the absorption of about that amount of power. It is presumed that every one knows that the watt is the unit of measurement of electric power, and is represented by one ampere of current flowing under one volt of pressure. In other words, the power of any current in watts is found by multiplying the number of volts pressure by the number of amperes of current. Now, as volts and amperes are as easily read from the proper instruments as steam pressure from a pressure gauge, it will be seen that the power in watts required to drive the lamps under test is easily obtained, and, when obtained, is easily translated into the more familiar unit of the horse power by the relation given above, that 746 watts equal one horse power.

But finding how much power is required to operate a lamp without finding how much light it gives would be as senseless as weighing the coal used at the boiler and not measuring the power obtained from it by the engine.

To find the candle power of a lamp, it is necessary to have the means for comparing it with a standard candle, or with a lamp that has been tested and calibrated to a certain known brilliancy. For use in testing lamps the box shown in Fig. 2 has been constructed. It is 12 x 12 in. by 16 ft., and is wired, as shown, for two lamp sockets with sliding spring contacts, each socket being moved independently of the other to any desired position within range of the box by means of cords, pulleys and hand knobs near point of observation. The principle is described in most works on light, and it is simply the casting on a screen of two parallel shadows of a single object, C, from different sources of light. It is only necessary to adjust the lights being compared so that the intensity of the shadows is the same. This may seem to be a matter of judgment as to vision, but it will be found that there is but a single position where lights of different intensities will produce the same shadows. The powers of the lights will be directly in proportion to the squares of their distances from the screen. Thus, if one lamp is at three times the distance of the other, its illuminating power is nine times as great.

This apparatus is nothing more than any one who knows enough to keep out of the way can make. It can be shorter, if only lamps of comparatively low c. p. are to be tested. The top should be in sections for ease in getting at the lamps. The end at A should be of ground glass, for external observation, and there should be a peek-hole at B for use when a white cardboard is used for a shadow screen.

With these simple appliances any user of lamps can satisfy himself as to the relative value of any offered him for sale.

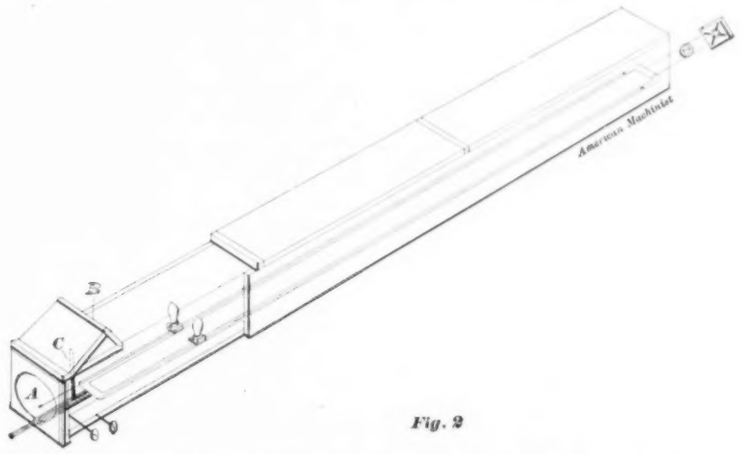


Fig. 2

He can also establish a limit of energy consumed and light produced, beyond which he will not use a lamp. Occasionally a lamp will be found that will have a wonderfully long life so far as the filament holding together is concerned. I have one that has burned 2,200 hours, but it is not much more than a curiosity, as it uses 1.5 amperes and produces but two candle power of light. Very many lamps tested have used from .8 to 1.4 amperes, and given but from five to eight actual c. p. Let us see how the figures would look in the case of a 1,000-light plant under such an increase of energy and decrease of light. If we have 1,000 new, actual 16 c. p. lamps at 500 amperes and 110 volts, we would have 55,000 watts, producing 16,000 c. p., which would give 3.44 watts per c. p. Now, when these lamps have depreciated until they use 650 amperes at the same voltage, and give but 10,000 c. p., we find we have used 71,500 watts, or 7.15 per c. p. How about the engine and coal pile in the meantime? As an electrical h. p. is 746 watts, the 16,000 c. p. would be produced by 73 + h. p., while the 10,000 c. p. illumination would require 95 +. If such a plant happened to have a 100 h. p. engine to start with, they might be all right, but if they only had 75 they would have a pretty good overload to contend with. Result, slow speed, low voltage and complaints. Very few engines of this size use less than four pounds of coal per h. p. per hour, and the 22 h. p. above referred to would use nearly 100 pounds per hour—quite a loss for the privilege of using poor lamps.

After finding out the energy a certain lamp consumes and the c. p. it gives out, the next and last is to find out its efficient life. This can only be determined by keeping a complete history of it while in regular use. It is a good plan to put lamps of different makes on to some circuit where the time burned is the same, and where their comparative brilliancy can be observed. Surprising differences will be found to exist between lamps, and great discrepancies will be observed between the facts as you find them and the data given by the makers.

When lamps are to be tested, an account should be opened, and each and every fact should be noted for every fifty hours burned and as long as the lamp remains economically effective. For, if the filament holds together, there will surely come a time when it will not pay to keep the lamp in use for illuminating purposes. After this time is past, the lamps had better be given to the ladies for the construction of needlework, or kept on a shelf near the window in your bedroom for use as missiles to accelerate the movements of cats engaged in nocturnal concerts, for which purpose I have found the bursting of the globes on a backyard fence to be remarkably effective.

To illustrate the use of the testing board described above, and show the advantages that may be derived from having the means of finding out just what any particular lamp will do, and what its economy is in comparison with other lamps, the accompanying table of results is given. For obvious reasons the makers' names are represented by letters. In one case, where a lot of lamps was rejected for not being up to the specified efficiency, the agent came to inquire what we knew about lamps, anyway. For his edification and satisfaction, twelve of his lamps were tested in his presence, and when he saw the result he acknowledged the correctness of our test, asked us to return the lamps, and blamed the shipping clerk at the factory, who, he said, had probably been trying to get rid of a poor lot, made some months before. I do not know if the clerk got a raise in his salary for his zeal, but do know that the next lot was fully up to the guarantee. It will be noticed that with some of the lamps of high candle power, the efficiency per candle power is higher than with the usual size of lamp. One lamp of 50 c. p. is still efficient and economical after 900 hours' use. To show the relative efficiency of low tension arc lamps run with current from an incandescent circuit, attention is

called to the entry under letters L. T. Arc. In this case the two lamps were in series, and wired through the instruments on the board. The rated c. p. (1,200) is assumed to be the true one, as the photometer illustrated is not suitable for lamps of this size and capacity. Even if the c. p. is but half that rated, or 1,200 for the two, they are still far ahead, so far as light produced for power is concerned. Under K will be seen the poor economy of using an old lamp. The watts per c. p. are figured from the makers' rating of the c. p., and not from the results of the photometric tests. The variations, however, are slight in most cases.

Make.	No. Tested.	Volts.	Amp.	Rated C. P.	Actual C. P.	Watts per C. P.	Remarks.
A.	1	115	.44	16	16.8	3.15	
B.	12	115	6.25	16	15.5	3.73	
C.	6	115	3.36	16	16.3	4.02	Same lot of lamps.
D.	12	115	6.72	16	16.3	4.02	
E.	10	115	6.	16	17.4	4.31	
F.	1	115	1.10	32	18.	3.95	
G.	1	115	1.66	50	48.9	3.81	
H.	1	115	4.25	200	199	2.44	Giant Inc.
I.	1	115	8.25	300	310	3.16	" "
L.T.							
Arc.	2	115	8.5	2,400	....	.407	In series.
K.	1	115	.80	16	9.4	9.8	After 1,600 hours

Our friend, J. F., of Plainfield, N. J., and many others should be aware of the fact that it is an invariable rule of this office not to reply to anonymous communications, or any communications whatever that are not signed by full name and address of the writers.

In melting pig iron in a cupola how much of its silicon is burned out? Silicon is not evenly diffused through either pig iron or castings, therefore it is not possible to obtain an analysis from drilings that will accurately give the silicon in either. The heat of the cupola, the rapidity of melting, the quality of the fuel and many other conditions exert such an influence upon the silicon that the loss of silicon will vary. The making of gray iron castings very fortunately does not require an exact percentage of silicon. The lower the silicon in pig iron the less the loss. Silvery irons containing 5 per cent. silicon will impart the most of their silicon to the mixture. Silicon iron with silicon over 7 per cent. costs more than that with lower silicon and much more of the silicon is lost, and worse than that, the silicon will not be evenly diffused in the casting. Pig iron varies in composition so greatly from day to day, that its exact composition cannot be determined. For this reason several irons should be used so that a chance variation in one will not greatly influence the castings.—W. T. Keep, in "The Foundry."

Condition and Prospects of the Machinery Business.

Letters from Machinery Manufacturers to the "American Machinist."

In accordance with our annual custom, we have asked leading manufacturers in machinery and kindred lines to write for publication their views as to the present condition and future prospects of business. Some of the letters received in reply follow, and others will appear in our next issue.

Acme Machinery Company, Bolt, Nut and Special Machinery, Cleveland, O., write us:

We began the year 1895 with high hopes for a better trade than we had in '94. The first month or two were rather disappointing, then began a steady increase in the volume of business, which soon carried us up to our full force and capacity. The last two months we have been obliged to run twelve hours per day, and find it difficult to keep up with the constant increase of orders.

Inquiries still come in freely for our productions, therefore we look forward to 1896 as a prosperous year. We have more confidence in the future, for the reason that this expanding volume of business in machine tools seems to be gradual and unaccompanied by any symptoms of a "boom."

Backus Water Motor Company, Water Motors, Exhaust Fans, Gas Engines, Newark, N. J.

Business at the present time is, and has been, better than it was a year ago, and the prospects for 1896 we believe to be better than they were for 1895.

We have somewhat enlarged our business by the manufacturing of a gas engine, which has its effect on our trade.

Bickford Drill and Tool Co., Machine Tools, Upright, Radial, Universal Radial and Multiple Drills, Boring and Turning Mills, Cincinnati, O.

The past year has been, beyond doubt, much more satisfactory than the one before that. We have enjoyed a good business the greater part of the year, and especially in the latter half, and, judging from the present indications, all prospects are favorable for a continuance. We have during the past year brought out quite an extensive line of bicycle drilling machinery, and also some entirely new radial drills, which have been illustrated in the "American Machinist." At the present time we are at work on an entirely new line of upright drills, which machines will embody new features which have never been placed on this class of machinery in the past. We are pleased to state that our shop is now running full in every department, with as many men as we ever had, and we are very busy. We are also happy to state, that negotiations have about been completed which will result in the erection of a new factory building for us in the early spring. We are also pleased to say that during the year just closed we have established several new connections in foreign countries, and expect our foreign trade to increase very nicely in 1896.

The Billings & Spencer Co., Machinists' Tools and Drop Forgings, Hartford, Conn.

Our business for the year 1895 has been much in excess of the year previous. Probably there will be about 25 per cent. increase, although we find prices of product much less than in the year 1894. Prices of labor have remained about the same with us as the previous year.

We have good orders on hand, especially for our output of bicycle wrenches, of which we have sold our entire production up to April 1st. We look to a good business for 1896.

Cleveland Twist Drill Company, Twist Drills, Reamers, etc., Cleveland, O.

Our business for 1895 has been larger than for any previous year in the history of our business.

We completed a large addition to our factory in March of this year, which is 110 feet long, three stories high, with a fine fireproof basement and first story. These two fireproof stories are used exclusively for stock room, packing and shipping departments. Our stock room, as at present arranged, has been pronounced by several competent judges to be the best of its kind in the country.

We have rearranged the entire factory, with the view of giving each department more room, and although we have added quite a number of machines, we still have plenty of room to increase our facilities all that is necessary to meet the continually growing demand for our goods.

We are well satisfied with the volume of our year's business, and are looking forward to an increased business the coming year, and see no reason why our best hopes should not be realized.

Curtis & Curtis, Pipe Cutting and Threading Tools and Machinery, Bridgeport, Conn.

We have enjoyed a very good business throughout the year, running our works at full time and with a full force. During part of the time the works ran for thirteen hours a day. During October we did the largest business of any month in the history of the firm. We look for great things next year, and if we are not disappointed, will be obliged to increase our capacity in order to meet the demands of the trade for the Forbes Patent Die Stocks.

Dietz, Schumacher & Co., Machinists' Tools, Cincinnati, O.

We are hardly in the position at present to give you a detailed account of our improvements, enlargements, etc., in the last year, owing to our being on the eve of making so many and varied changes in our present line of manufacturing. We propose, by ninety days, to be in our new quarters, 90 x 200 feet, made of structural iron and brick.

During the past year we have added to our former capacity: Five of our latest improved engine lathes, one automatic Brown & Sharpe gear cutter, one 30 x 30 x 16 spiral gear Gray planer, one latest improved Garvin milling machine, one Universal Landis grinding machine, one new special boring machne (our own make), one latest Le Blond drill press, one 15-inch steptoe crank shaper, and in view of our increased capacity in our new building, have placed an order with the G. A. Gray Co., this city, for one of their 38 x 38 inch x 24 foot spiral gear planers. Within ten days will place our order for either a Corliss or Cross com-

pound engine of latest modern designs, of over 100 horse power.

In view of as steady an increase of our business in the future as in the past, we have modeled our new structure after the lines of the Ordnance Building at Washington Navy Yard; to be constructed entirely of iron and brick, with solid foundations for all heavy tools.

When established in our permanent quarters, we shall then push our newly introduced 14-inch, 16-inch and improved 18-inch engine lathes, our 24 x 36-inch and 26 x 44-inch double spindle lathes, and shall add to this a complete line of our special grade screw machines, drawings and plans for which have just been completed. On these tools alone we are determined to enter the market, convinced that with our greater facilities for handling trade we will be enabled to safely place our machines in domestic competition, as well as double our trade abroad.

J. A. Fay & Co., Wood Working Machinery, Cincinnati.

It has been some time since business conditions warranted addressing you in a hopeful tone. The "hard times" came upon us with about the same severity that was experienced by almost every concern engaged in business where iron and steel were the chief commodities in use.

During the period of depression we found it unnecessary to enter very largely the field of improvement in our shop practice in the enlargement of the plant, or in extending the territory to which we looked for a market. We are pleased, however, to note for some time past a marked improvement in the tone of our correspondence, in the number of our inquiries, in the demands for machinery both at home and abroad; an increase in our shipments, smoother sailing in making collections, and, in fact, a healthier tone in our general business affairs.

We are quite busy in many of our departments, are adding to our force from time to time, and our satisfaction over the outlook for 1896 would be unalloyed, were it not for the one fact that has thus far proved insurmountable—our inability to advance prices for our manufactured product.

Raw material, as is well known, has advanced considerably, but we are not prepared to demand of our customers a proportionate advance in making them quotations. We are hopeful that the business for 1896 will be increased to that extent, that we may derive from it our reasonable profit. We may not have this satisfaction, however, until a complete change in the Administration.

Fox Machine Co., Wood and Iron Working Machinery, Grand Rapids, Mich.

We are pleased to report a very satisfactory year's business in all of our different lines.

Our machine tool business has been gradually increasing through the year, the rush being especially on tools for manufacturing bicycles, on which we have been kept exceedingly busy, and have orders on hand for about sixty days ahead. The bicycle business, which we took up a year ago, has been gradually increasing, and this year we shall not only place upon the market the same model that we sold last year, with some improvements, but shall have five other new models that we shall add to our line.

Our steel hardware department has been increasing, and we have found it necessary to double our facilities for producing this class of goods. We have added a large-size punching press and an 8-foot squaring shear to our line of press tools, and these like all the other machines we are manufacturing, are those we brought out first to meet the requirements of our own business.

In order to make room for the increase in our different lines, we have added a four-story brick addition to our main building, 42 x 92 feet in size. We have also added a boiler house, 30 feet square and three stories high.

We anticipate a good business for 1896, but feel, with many others, that were it not for the demand which the bicycle industry has created for tools and steel, that the general state of business at the present time would be anything but satisfactory.

In connection with our line of bicycles and bicycle tools, we shall be on the market with a list of bicycle specialties, which, we anticipate, will have a very large sale, and we hope at the close of 1896 we will be able to give you as good a report and with as bright a prospect as at the present time.

Frick Company, Eclipse Machinery, Corliss Steam Engines, Ice Making and Refrigerating Machines, Steam Boilers, etc., Waynesboro, Franklin Co., Pa.

Our business during the past year was good, showing a considerable increase over that done in 1894. The outlook for next year is also encouraging, as we have more orders than usual at this season of the year. Have made no advance in wages, as we find it necessary to still sell at very close margins.

Hill, Clarke & Co., Iron and Brass Working Machinery, Boston.

We are pleased to say that our business, both at Boston and Chicago, has been quite satisfactory for the year of 1895. Our trade, however, has been, to a very large extent, from bicycle manufacturers, while general business has been rather quiet. Had it not been for the bicycle trade, our business for 1895 would have been very light indeed.

Nearly every one in our line is looking for improvement in general business for 1896, and we think all the indications point that way.

Hurlbut-Rogers Machine Co., Patent Cutting-off and Centering Machines, South Sudbury, Mass.

Business has been driving since July 1st, and we have been unable to keep up with our orders. We consider that prospects for 1896 are good.

Joseph Dixon Crucible Co., Graphite, Plumbago, Black-Lead, Pencils, Crucibles, Stove Polish, Lubricants, and Graphite Products of all kinds, Jersey City, N. J.

The Dixon Company approaches 1896 in the mood expressed by Ralph Waldo Emerson when he used the words, "divine discontent." This means a certain discontent, yet not unreasonable or querulous dissatisfaction.

As to gross sales, the Dixon Company, in 1895, scores a good percentage over 1894; as to collections, they also have been good. As to bad debts, they have been few. For us, 1895 has been a year of satisfactory progress not only, but a year of seed-sowing from which we hope a liberal harvest. Thus much for our content.

For discontent, we think that the whole business world, including manufacturers, jobbers and small dealers of all kinds are asking for too small margins of profit, and that, as far as the stockholders and others are concerned, who profit by the earnings of the various business houses of the United States, they are the poorest paid people in the community. They do too much work, carry too large responsibility, experience too much wear and tear, for the margin of profit they get.

Not long since, the writer was talking with a jobber whose gross sales were in the millions. His percentage of profits was less than 5 per cent. on the gross sales. With another the percentage of profits was 3½ per cent. The amount of gross sales to reach these large figures means the handling of an immense quantity of goods. The executive ability to guarantee successful results is immense. The responsibility is more than immense, while the earnings are below the minimum. The writer believes that the margin of profits on the manufacturing and sale of merchandize all over the United States is less, at the present time, than in any other part of the civilized globe, and there should be a revolt and a strike on the part of every one connected with the manufacturing and distribution of goods, to do something in the way of better net earnings.

This is our sermon to the business community for the holiday week of 1895.

Kempsmith Machine Tool Co., Iron and Brass Working Machinery, Milwaukee, Wis.

Our business in 1895 has been double that of 1894, and we have often run nights during the year in order to make deliveries on time. At this writing we have orders booked that will carry us well into the new year, and we confidently look for a still further increase in our business in 1896.

We have added, during the year, several new and improved machine tools, as well as making special jigs and fixtures to improve the standard of our work, as quality with us is always the first consideration.

We have also improved our line of tools throughout, and expect shortly to have the pleasure of seeing some of our improvements shown in your columns. Wages have advanced, so that at present we are paying as high as before the panic. Material has also advanced, but the selling price has not advanced in proportion to cost.

Manning, Maxwell & Moore, Railway and Machinists' Tools and Supplies, New York.

We find a volume of business quite satisfactory, but prices are ruling very low, and the margin of profit is very much reduced. In general, business is not at all satisfactory, as the expenses of business are as great, or even greater, than they were when we had a larger volume of business and much better prices.

We do not offer any prophecy for 1896, as, in times like these, all prophecies, when based upon experience, seem to be at fault, and it is quite as safe to wait for facts to develop as to attempt any forecast.

Marine Iron Works, Marine Engines and Boilers, High Pressure, Fore and Aft Compound, Triple Expansion and Paddle-Wheel Engines, Steam Launches, Steam Yachts and Tug Boats, Chicago.

We are pleased to report an increasing

demand and an encouraging tone as to the character of machinery wanted, but with little improvement in the prices, which are somewhat too close to the rocky bottom for special work.

Small and medium sized marine work is an exclusive specialty with us, and while sales of pleasure craft during the past year have been moderate in number and value, current quotations would indicate that 1896 is likely to show an appreciable improvement over the past season.

The enlargement of our working plant consisted principally in adding special tools to our machine shop, and (times considered) a rather large addition to our line of patterns for engines, propeller wheels, deck equipment, etc.

Meriden Machine Tool Co., Forming Lathes and Special Machinery for Economical Manufacturing, Meriden, Conn.

The year 1894 was, at its close, the best in our history, and up to December 1st, 1895, we have shipped 10 per cent. more than in the corresponding months of 1894.

We have added to our plant the special screw planer for making forming tools, which was lately described in your paper, and are expecting every day a No. 5 Kempsmith milling machine.

We have also added a blacksmith shop at the back of our main building, and have equipped the same with better facilities for hardening than we have before enjoyed.

We have also added to our facilities for grinding, both surface and cylindrical.

Inquiries are coming in well up to date, and we expect a good business the coming year.

Mitts & Merrill, Giant Keyseaters, Power Punches and Shears, Power Spring Hammers, Saw Grinders, Saw Mill Specialties, Saginaw, E. S., Mich.

Business has been good with us during the past year. In fact, we have not felt the hard times, as our business has been increasing during the past three years, although possibly it might have been better with us if it had been generally better throughout the country. Trade in our sawmill specialties has been quite satisfactory, and orders for our key-seating machines are as numerous as we can attend to at present. We expect soon to be able to manufacture these machines more rapidly, so that we can take care of all orders promptly. Our new machine seems to strike the trade so favorably that we are looking for a largely increased demand.

The National Chuck Company, Lathe Chucks, Universal, Independent, Combination, Planer Chucks, Planer Jacks, Drill Chucks, Spring Vise Jaws, Errington's Automatic Tapping Attachment, Metal Working Tools, New York.

Business picked up wonderfully with us this last year, and has shown steady improvement, although the early months were most marked in their advance. This I consider to be due to the fact that stocks were exhausted throughout the country, and had to be replenished at the beginning of the year. 1896 promises to continue the improvement, without any sensational indications. The price of labor and materials has slightly advanced, and the market price will undoubtedly reflect this sooner or later.

I note an increasing demand for our goods, in common with other American manufacturers, for export.

New Doty Manufacturing Co., Hand and Belt Power Punching and Shearing Machines, Janesville, Wis.

Our business during the past year has not been very satisfactory. We had a fine trade, considering the hard times, but not nearly up to the volume of first half of 1893. The price of labor remains about same as last year. Iron and other materials are higher. During the past year we built a new foundry with core room and sheds for storage of iron, coal and coke. We equipped the foundry with a new cupola and crane, and in other ways prepared to do more and heavier work. We also built a new and practically fireproof pattern storage house, and purchased some new tools for patternmakers' use. We have brought out a few new tools, and are now at work in drawing room on several lines of presses and shears for sheet metal work, such as we have not made before. We have worked steadily through the year ten hours a day, but not with a full force of men. As to future prospects, we cannot predict. We are receiving a good many inquiries, but cannot tell what will come of them.

New Haven Manufacturing Co., Machine Tools, New Haven, Conn.

Our business has increased about 50 per cent. over the previous year, and we have been able to advance prices somewhat for our manufacture, this being necessary on account of increased cost of our machinery. We have made very great alterations and improvements in our patterns and workmanship of our machines. We have not enlarged our works the past year, but have been obliged to add a considerable amount of new machinery, and still are behind in filling demands for certain machines.

The price of labor with us has not advanced very materially as yet. Material, of course, is some higher, and that, with labor, will be costing us more from time to time.

As to prospects for the coming year, we feel very hopeful, and believe that the year 1896 will be a very satisfactory one indeed.

New Process Raw Hide Co., Gears, Washers, Raw Hide Bound Mallets and Chisel Handles, Gears for Electric Railways, Syracuse, N. Y.

We have to report the heaviest trade for this year which we have ever had. The increase has been steady all through the year, and the indications for next year's business are rather better with us than ever before. We are well satisfied both with what has been accomplished in 1895 and the prospects for 1896.

Penberthy Injector Co., Penberthy Improved Automatic Injector and other steam specialties, Detroit, Mich.

The past year has shown a good advance over 1894. We have been forced to add several new lathes to our works to get out our orders, and in order to not have to purchase still more next spring and summer. We are working our entire force, and shall do so all winter. This will, of course, accumulate a surplus stock during winter months, but will enable us, with such reserve, to fill our orders promptly during 1896. Everything points to a good trade next year. We have already closed our contracts with nearly every traction engine manufacturer in the United States for next season's supply, and from their requirements we imagine they are also looking for good business. We have outgrown our present quarters, and in the spring shall add an adjoining factory to our present building, giving us a new factory, 60 x 100 feet, four stories, our present works being 54 x 100 feet, three stories.

Q. & C. Company, Railway Specialties and Special Machinery, Chicago.

With the signs of better times in the early spring of 1895, we brought out our new Q. & C. shop saw, and also energetically pushed the sale of the machines for other sizes of work, the result of which has been very satisfactory.

We have done, in the last six months, probably five times as much business as ever done before by our Company in the same line of work and for the same period of time, and the inquiries and promises that we have on hand would indicate that we may look for a much larger business in 1896.

As to changes in price of labor, etc., would say that our large increase of orders has allowed us to increase the price of our labor, pay more for our material, but at the same time to be placing our machines at an equal price, and in some cases at a less price than before.

The Skinner Chuck Co., Independent, Universal and Combination Lathe Chucks, Planer Chucks, Drill Chucks, Face-Plate Jaws, etc., New Britain, Conn.

Our business has been improving the past year, though the improvement from month to month has not been uniform. The price of goods is low, and the margin of profit small; but the increased demand has warranted an enlargement of our works, the introduction of new machinery and an increase of wages to workmen. We have brought out some new varieties of chucks the past year, and have materially improved the styles of our regular patterns. By the employment of skilled workmen and the best machinery to be obtained, we have been able to meet the requirements of our customers for tools for special machines; and though for a part of the year we have found it difficult to keep up with our orders, we believe that with the new machinery, now making, we shall be able to fill future orders promptly. We consider the outlook for 1896 encouraging, though we have no expectations for a boom in business.

The Taunton Locomotive Mfg. Co., Founders and Machinists, Wainwright Improved Corrugated Copper Tube Feed Water Heaters, Surface Condensers, Expansion Joints and Corrugated Copper Gaskets, Flange Pipe and Special Castings, Heavy Printing Presses and General Machinery, Taunton, Mass.

Business for the year ending with December, 1895, has shown a decided improvement in volume, but we cannot report an equal improvement in prices to be obtained. In feed water heaters we have been fortunate enough to secure orders for some very large sizes, and, owing to our equipment, we prefer that class of work.

Trump Bros. Machine Co., Light Machinery, Finished Hexagon Nuts, Stud, Coupling and Tap Bolts, Wilmington, Del.

The volume of our business from January 1st, 1894, to December 31st, 1895, will

show the largest year's output in the history of the Company.

We have added several standard tools during the year, consisting principally of milling machines, drill presses, shapers and screw machines, and a very great many special tools and appliances of our own design and manufacture.

Up until about the first of November we were running almost to our capacity, and a considerable portion of the time night and day. During the last thirty days orders have fallen off, and we are gradually reducing our force.

The indications for increased orders in the near future are not particularly bright.

Wages and material have increased in cost, while the prices of our finished products have been reduced in several lines.

If our legislators will correct the errors of the "Cleveland-Gorman-Wilson" fiasco, so as to insure a fair protection to our manufacturers, particularly in the knit-goods industry, we look for renewed activity.

Weston Engine Company, Engine Builders, Painted Post, N. Y.

At the present time we are enjoying a very fine trade, and have orders booked that will keep us running on extra time for the next two or three months, and the prospects for 1896 are indeed very bright. We are shipping Weston engines to Cuba and South American countries, as well as several to the Pacific coast. Although trade during the past year has not been wholly satisfactory, yet we have not made any material change in the price of labor, although materials during the past two or three months have advanced.

Doings at Backaway.

Editor American Machinist:

Did you ever notice in your tramp days, when you were looking to strike a town you never heard of before, where they made something different from anything else in the world, did you ever notice that when you run right up against a real good shop you were rather certain to strike a good town to live in? A town full of real good fellows, and I don't mean that the shop should be of the way-up kind, not necessarily, but one of these shops that you felt at home in; felt as if you had some sort of rights and interest in the world. One in which you felt at home with the foreman, the superintendent and even with the proprietor, with no "stated occasions" about it?

Perhaps you had to skirmish around a little for tools to suit your taste, and there may have been other things about that shop that you wouldn't have liked if you had ever stopped to think about them, but you didn't stop to think. Or the shop may have been one of the best equipped in the land; just rigged right up for splitting the ten-thousandth of an inch, and finding out when you had split it right. It don't make much difference which kind of a shop it is. There's a good deal more to a machine shop than fine tools and equipments, as nice as these may be. There's the intention that you can't get behind, or around, and wouldn't if you could.

Everybody likes the shop because he is made to feel himself a part of it. When men outside the shop speak of it, they don't refer to brick and mortar so much as they refer to humanity, and a machinist is a good deal like other mortals after all. Just sizes up about like the other fellows who have to scatter themselves around considerably for bread and butter. He likes to get that, and he likes to get something else. Sometimes he has just about as clear an appreciation of what is right and comfortable as a member of Congress, and sometimes a good deal more.

Did you ever think seriously upon what that machine shop with its contented workmen has done for that little town? I'll tell you: If it's a good sized shop, it's smoothed up a lot of rough places all round about itself. It's brought a lot of good fellows to town, and there's lots of other good fellows waiting for a chance to come. The old bridge with its piled-together appearance comes to look like a pretty good piece of architecture, and the macadamized road on the main street is rated better than any paved roadway in the world.

To be personal, I struck such a shop once. The town wasn't much of a town, not at first sight, but the shop was a genuine good one, and just as other good shops have done it had made a good town of Allville. I met Johnson—just as good a fellow as ever lived, at Allville. He was a skilled blacksmith, on small work. Never welded anything in his life larger than a two-inch shaft, and that was rather an emergency. But he could do what he knew how to do, and do it just right.

Johnson didn't work at the big shop I struck. He had worked for ten years for Crowsly, who had a little shop right next door to the big shop, as next door goes in small towns.

A curious individual this Crowsly was, which stands for saying he was just about like the rest of humanity. He had served a regular old-fashioned apprenticeship at the machinist's trade, then unfortunately he fell heir to fortune enough to last two of him. But Crowsly wanted something to busy himself about when he couldn't go fishing, so he built a little shop at Allville. "Kind of knitting work," he called the little shop. Built it there mainly because there was good fishing all around, and not much work for the shop. Never had an idea that he would make the shop bigger, or anything of the kind. Just let it stagnate; make a place to get into once in a while, when there was no where else to go.

After a bit, Johnson strayed along and went to work for Crowsly. Just the thing for both of them. Kind of fitted one another, Crowsly and Johnson did. Crowsly rattled around in the machine shop, bossing one journeyman and an apprentice, and Johnson let himself loose in the blacksmith shop, with a helper to keep straight. Johnson got good living wages, and Crowsly, as general manager and proprietor, pocketed the losses and made the balance good out of his comfortable bank account.

When work was slack with Johnson, which was pretty much all the time, he tinkered in the machine shop, and Crowsly argued with him till he could get right down to a sixty-fourth of an inch, which was near enough for the work in the little mills in the surrounding country, from which they would bring in a hole in a pine board for size. With Johnson's surroundings, what wonder that he grew up with the idea that he was not only a good blacksmith, but a pretty good machinist?

So time went on till Johnson struck luck. He just tumbled right into a few thousand dollars left him by an uncle. Then he wanted a machine shop of his own, just as any one else would.

Johnson had a long talk with Crowsly about the matter.

"I'll tell you just what it is," said Crowsly. "You want a shop and I don't need one, don't have to have one, but I want it just the same. You want the shop to make money out of. I want a shop for just a resting place. That makes a big difference. You want to go fishing when there's nothing to do in the shop; I want the shop to go into when fishing is slack. I've run this little shop twenty-five years, and I've never made a living in any one of them. You wouldn't be contented at that. You want to make some money, and perhaps you will. I should advise you, if you will go, to buy out Omervil. Told me last night he was getting too old to run a shop. Buy out Omervil and you'll have a little business to spread out with, and shop room enough for four times as much. I'd sell out to you, but if I did I shouldn't know what to do when times get dull in the lake. Don't want you to go, Johnson, but if you've got your heart set on it buy out Omervil.

"I'm afraid you'll want to spread out too fast then, but take my advice and never tackle a job that you don't know all about, and haven't got tools to do. If you stick to that, if you don't make any money you may make pretty nearly as good a living as you do now, and in the end leave things built up so the next incumbent can make money. Never could see much in that myself, but others do. See Omervil, and tell him I sent you."

The upshot was Johnson saw Omervil and bought him out, good will and all his shop belongings.

Johnson put in more tools as he found use for them, but he kept right on in the old line of trade. Knew that, he said, and didn't know anything else.

But an evil day came. There was only a plug branch of a railroad to Allville, and that got a train in when there wasn't anything else to do. Allville had started out to be a metropolis, and this plug road

business wouldn't do. There was a lake that extended from Allville to the main line of road, and enterprising citizens established a line of boats, and built a little dry dock. Then competition came in with another line, and tug boats were built to touch at the corners, and Lake Grotoo became quite famous. The work on the boat engines, and the boats, all went to the Other End, about fifteen miles from Allville. Johnson's shop was the only one near the landing, and boat owners, backed by townsmen, could never pursuade Johnson to touch so much as a bolt on one of the boats. Said he didn't know anything about steamboats, and that was true. Johnson's shop was close to the landing, but the steamboat business was started since the shop was, and that was started for other purposes, and he proposed to stick to his last, like the cobbler.

But, as has been said, his evil day came, as it comes to many another.

The steamboat Great Original, of the Only and First Line, broke her propeller shaft. The superintendent of the line was on board, and he made up his mind that he would have that shaft welded at Allville. He signaled for tugs and went right into dry dock, then he started for Johnson's shop. Johnson stood right out like a rock. Wouldn't touch the shaft. Didn't know how to weld it, and had no fire fit to heat it in.

Then the superintendent got in his work. Told Johnson that he was brought up on just such work as welding large shafts, and he would come right in and look after the whole thing and guarantee the job.

Johnson yielded, yielded against his better judgment. The shaft came and the superintendent got his coat off, bossed the welding, and pronounced it all right. Just five minutes away from dock it let go right where the weld ought to have been, and the boat was towed to the Other End.

Now the superintendent was one of the kind of men that was never in the wrong, not if he could help it. Allville hadn't got to be a metropolis, not so far. In about two days everybody had it in his mouth that Johnson had made an awful mistake, and that very serious disaster might have come from it but for the prompt action of Superintendent Allwell. Tried to weld that shaft, Johnson did, and didn't know how to do it anyhow.

Johnson's star was under a cloud. The Allville "Weekly Clairvoyant" had always known that Johnson wasn't fit to look out for the Allville end of the transportation business, just as if he had ever tried to, and that went broadcast through the country. It hurt Johnson's little business. His star was under a cloud to be sure.

I left Allville just after, and left Johnson making a good fight against destiny. Pretty soon I brought up at Backaway.

I never heard just a word from Johnson for five years. In the meantime I had gathered myself together at Backaway, the best way I could. One day the door of the little room into which I used to get for a chance to think was darkened, and Johnson was the man who darkened it. Didn't know I was there, but had just tramped in for a job, as you and I would have done.

I sat right down for an hour's good talk with Johnson. That propeller shaft that he ought never to have touched had been too much for him. Just broke him right up. Everything gone, inheritance and all, Johnson said, and he was looking for a job on his uppers. Wanted a job that he knew how to do.

Luck was for me once. Old man Van Dorn had asked me to send him just such a man as I knew Johnson to be, and I sent him. He's there yet, and Van Dorn is more than satisfied. Looks like a lifelong arrangement.

There are two sides to this, Mr. Editor. How is a man to get above the peg that holds him if he never undertakes something he has no training for? There must be some way, but Johnson says it isn't in trying to do something you don't know how to do when unpleasant consequences will follow a failure. There's too much lying awake o' night about it.

Very truly,

JOEL OLDONE.

LETTERS FROM PRACTICAL MEN.

Producer Gas Versus Steam Engines.

Editor American Machinist:

I have just perused the very interesting article which appeared in your valuable paper of Nov. 21st, and headed "Some Possible Products of Producer Gas." I believe that, in time, the gas motor may take the place, in the shop, of electric power transmission, although the maintenance of each little gas motor may be more expensive than an electric motor, and, above all, be more delicate in driving.

However, I must make you observe that the time has not yet come for us to see the consumption of gas motors to cost less money per horse power per hour than the steam engine.

I am keenly attentive to this question, and I hereunder put down some data I have found:

1st. Downson's gas costs at Gloucester 0.7 centimes per cubic meter (.0354 ct. per cu. ft).

2d. I know that the best gas motor consumes 2.25 meters (79.45 cu. ft.) of gas per h. p. per hour (producer gas). Thus the consumption amounts to 0.1575 centimes 2.8-10 cts.) per h. p. per hour, which is much more than a steam engine of the same power.

Confusion is always made with the producer gas engine as to the quantity of coal burnt, which often appears to be less than for the steam engine, but, coal for gas engines costing dearer, the steam engine should be preferred, and so much more that the steam engine has several other advantages over the gas engines.

I would advise, in order that each buyer may make a judicious choice, that the following items should always be mentioned in tenders for steam engines:

1st. Horse power absorbed to overcome the friction of the engine itself.

2d. Steam consumption between horse power the engine is sold for and one-half of that horse power. For the producer gas engine:

1st. Horse power absorbed to overcome engine friction.

2d. Gas consumption between horse power sold for and one-half of the same horse power. (It should be well understood that cost of gas to be employed should be specified.)

It has been proved, by Prof. Thurston's test, that the friction of a steam engine is practically constant at all loads using the same speed, and remains nearly unchanged loaded or unloaded.

With a gas engine this will be more true, seeing that there is not even one admission for revolution.

Having these two items, the most advantageous engine of the two systems will at once be shown; as we know the horse power absorbed by friction, we have the cost of that item per year for both engines. Knowing the steam and gas consumption respectively, the buyer will soon find out which of the two will be the cheapest to work, for the price of coal or gas (producer or rich gas) is always, at any point, known.

The steam engine is superior to the gas engine at the point of view of the gas consumption, when the gas engine is not much loaded, which is very considerable, and also because the gas engine cannot develop more horse power than the power the engine is sold for, and also because producer gas is very variable in its manufacture; and the variations of efforts are not so great in the steam engine, and the horse power absorbed in friction for gas engine is very considerable.

ARTHUR BOLLINCKX.

Brussels, Belgium.

Etching with Rubber Stamp.

Editor American Machinist:

In reference to your request for information in regard to etching on steel with a rubber stamp, I would state that I have had experience in that line.

Take asphaltum varnish and apply it to a rubber stamp. Make the impression on the steel with the stamp, and then make a border all around the impression and cover all parts not wanted to be etched with the varnish. Let dry, and then apply nitric acid. Let it remain on for a few minutes, and then wash with water. Then wash off the varnish with turpentine and

you will have the desired effect, i. e., the letters will be raised and bright.

Another way is to cover the steel with the varnish and then make the design with a scriber. It may require a little experimenting to get the desired effects.

S. R. PRESTON.

Philadelphia, Pa.

The Kink in the Calipers.

Editor American Machinist:

"Easy Way" assigns me to an honorable and important position in the entertainment provided by the "American Machinist." I feel the responsibility of the function to which I am assigned, and trust that if the show does not continue to draw it will not be the fault of the chorus.

I am thankful for the evidence furnished of the antiquity of the multiplying caliper. "Easy Way" personally knows that they date back "pretty well to 1800." My recollections do not embrace much of the first half of the present century, but I may say that I have spent the whole of every working day for more than thirty years of my life in machine shops, with less than my share of holidays and the full average of overtime, and I have never seen a pair of the multiplying calipers habitually or frequently used by any man. They have made remarkably slow progress. They exemplify the non-survival of the unfittest. They are not for sale in the stores, nor are they in the catalogues of the tool makers. By the way, some one invented or discovered these calipers again only three and a half years ago in the "American Machinist," where a cut may be found almost identical with that lately given us by Quirk. I can imagine how in the olden time they could have been used in an encouraging or persuading sort of way by the unfortunate vise hand. Whenever his arms wanted a little rest he could go over his work to see how much more he would have to rasp off, and in that way get some satisfaction out of them; but I cannot imagine any more important service that they would be likely to render. As to the use of such calipers by an expert latheman for fine turning it is absurd to talk about it. Think of a fellow following up a lively finishing cut on a slim and springy piece in the lathe with a pair of good machinist's calipers, and then think of the new man with these new calipers passing them over the piece of work, clamping the pointer with his thumb, as Quirk tells us, and then deliberately bringing them up where he can get a good look at them, his work running right along the while. That catching the pointer with the finger or thumb must require considerable knack, and I don't see how a man could tell the precise moment to catch it, and I don't believe Quirk ever saw it done except in his mind's eye. This range of the index, according to the account we have of it, would not make it possible to do any fine calipering with it even if it worked all right, according to the story that they tell. A thousandth of an inch is what lathe work must come to for some of the commonest kind of fits. Say that the length of the index arc is one inch, and that the range of the caliper is one-tenth of an inch, as Quirk tells us, then thousandths of an inch must be indicated, approximately, by hundredths of an inch on the index, and any one who has had much experience in reading hundredths of an inch on, say, a Brown & Sharpe scale, must know what fun it must be to do that in a quick and off-hand way on a running lathe job. I am afraid I have said more on this subject than it was worth.

TECUMSEH SWIFT.

Tests of Machinery Before Shipment.

Editor American Machinist:

We note in your issue of December 19th a letter on "Important Points Overlooked in Machine Building," and take the liberty of disabusing your readers of the idea that reputable machinery builders are so negligent as one would judge from reading the above mentioned letter.

The writer has been connected with the Fitchburg Machine Works and its predecessors, in the machine tool business, for over 31 years, and can say that, from the first year, our lathes, planers, drills, etc., have been set up in our works, run and inspected; and in that time the rigor of the tests has been increased as seemed necessary or advisable.

In regard to the definite information given by such tests regarding the power of our tools, will refer for lathes to the "American Machinist" of August 15, 1895.

The above mentioned points, the writer has good reason to believe, are also carefully looked after by all other standard, high-grade machinery builders. Although we may lead in some points, we do not stand alone in matters of this kind.

J. L. CHAPMAN.
Supt. and Treas. Fitchburg Machine Works, Fitchburg, Mass.

That Type-Setting Contest.

Editor American Machinist:

Mr. Grant's contribution on "Typesetting by Machinery" is particularly interesting to me, because I have been and am giving much time and attention to the production of a machine to compete in this field.

The contest to which Mr. Grant refers took place in this city (Chicago) and was not typesetting at all, though the product was equivalent to type set up. The machine used is known as the Linotype, and sets up a line of intaglio dies by being operated from a keyboard. Into these dies is cast a slug or "line of type," hence the name of the machine. While I did not witness that contest, and have no interest in promoting that particular machine, I have no reason to doubt the actual occurrence of the test as reported. There are, however, certain conditions that remove this test from the realm of practical consideration, and certain other conditions that show the speed not to be quite so extraordinary as Mr. Grant figures.

The contest served to show the extreme physical ability of the operators and is consequently not in the nature of practical work. A first class operator is able to set on this machine some 30,000 or 40,000 "ems" per day, or about one-half what was produced in this contest. That is, he is able to do this provided the machine does not, as frequently happens, get out of order. Even with all delays figured in, the machine is a distinct advance over setting type by hand, and has come to stay, barring the production of some better or simpler machine.

The marvelous speed with which keys may be manipulated is well illustrated by performances on the piano, but the idea that an operator can maintain an average of over six a second for seven continuous hours is a little too much. The average number of characters per "em" is between 1.5 and 1.8 and not 2. This may be largely reduced by making wide spaces between the words, and this was doubtless done in this case as the machine is well adapted for this purpose. The actual speed attained was probably between 3 and 4 per second.

Does Mr. Grant want to get a little of this kind of advertising and not tell lies of too colossal proportions? He can do it with the aid of money and manipulation in the following way: Let him get out a gear cutting machine a little more powerful and convenient than any yet made, with cutters to match as perfect as human skill can make them. Train a few operators to feed by hand to the extreme that the cutters will stand, and keep these men under pay while permitting them to seek situations with persons using the machines. Then by furnishing the money himself he can get one of these men to challenge another to a gear cutting contest for $500 a side. By having every condition in the way of cutters, metal, lubricant, etc., in the best possible shape for speed he might be able to get a record that would get into the papers, even if he did spoil ten per cent. of the gear teeth, ruin his cutters and have to send the machine to the repair shop. It is a great scheme for advertising, only it works somewhat better applied to typesetting than it would to gear cutting. Mechanics are apt to be a little too familiar with the practical limits.

C. L. REDFIELD.

Chicago, Ill.

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FRED J. MILLER, Editor.

Special Announcements.

☞ *We publish nothing in our reading columns for pay, or in consideration of advertising patronage. Space in the advertising pages only is for sale.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent on subjects pertaining to machinery.*

☞ *Every correspondent, in order to secure attention, must give his full name and address; not necessarily for publication, but as a guarantee of good faith.*

☞ *All communications for or relating to the reading columns should be addressed to the editor. All other communications to the company, as above.*

☞ *Subscribers can have their mailing address changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrapper denotes week with which subscription expires.*

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The New "American Machinist."

The "American Machinist" is, we know, looked upon by thousands of readers as an old and dear friend, and many of our readers, when they see the present number, will, no doubt, experience a shock comparable to that we sometimes feel when meeting an old friend who, in some way, has entirely changed his appearance, and looks like a new man.

We soon discover, however, that our friend has the same voice, speaks the same language and has the same heart beating in his bosom—and these are the essentials.

It will be found the same with the "American Machinist," it will be the same paper, "only more so." By this we mean that the paper is, to-day, much better prepared than ever before to deal with matters within its field. Those who will henceforth guide and control it are personally in touch with mechanical matters and with machinery interests, and are fully alive to the fact that the art of machine construction is a very progressive one, and that it is important to keep step with the procession.

In re-designing the paper we have had in mind only how best to make actual and practicable improvements; no change having been made without what we consider good and sufficient reasons.

In the first place, we have thought best to "practice what we preach," regarding standard size, and the paper is, therefore, 9x12 inches, which is the large catalog size, and, folded in the middle, horizontally, becomes 6x9 inches.

Reducing the size of the page, we have at the same time increased the total amount of space and have arranged so that the middle form can be variable in size, and the paper can, therefore, readily expand or contract; its co-efficient of expansion being determined by the combined pressure of reading and advertising matter. Every number will contain more reading matter than in the old form, and this number has more than twice as much.

The cover will protect the paper, keep it clean and in good shape for binding, and the advertising pages are so attached that they may be taken off when the numbers are to be permanently bound, thus reducing the bulk of the bound volume, which we think very desirable. Advertisements are things of to-day.

For ready reference, we have added an alphabetical list of advertisers and a classified list of things advertised, which will be found convenient by those who wish to know where to look for a particular thing and who realize that "life is short."

We have thought it appropriate that a machinist's paper should be made by machinery, so far as possible, and the type for this number has been set by machinery; as all future numbers will be if the work proves satisfactory, as we expect it will.

In inaugurating our electrical department with this number, it will be expected that we should announce its purpose and scope.

The use of electrical apparatus, either as a means of lighting or of transmitting power, has increased so rapidly of late that an acquaintance with the machinery involved and with the principles of its operation has become well nigh imperative with a large proportion of our readers. These applications, especially to power purposes, involve in many cases deeply interesting problems of a mixed mechanical and electrical character, although the electrical press has heretofore in large degree discussed such problems from the electrical standpoint only. Again, electrical machinery is of so highly specialized a construction, that of necessity, a large number of new methods and appliances have been developed in its manufacture and the extent of the industry is so great that large numbers are directly interested in the description and discussion of these methods, while such developments of his craft are of an indirect interest to every machine constructor in whatever field he may labor.

It will be our special province to treat the applications of electricity from the standpoints outlined above. There will be none of that injudicious "booming" of all appliances which may happen to have an electrical attachment, to which booming a portion of the electrical press has been addicted. The development of electrical work has been so rapid that it is perhaps natural that electrical editors should have been at times carried off their feet in the current of enthusiasm which surrounds them, but it is, nevertheless, a fact that the best manufacturers of electrical machinery as a rule deprecate indiscriminate and promiscuous booming of everything electrical. We shall endeavor to avoid this error and to simply treat electricity as one of those "forces of nature which have been applied to the uses of man," and which as such has certain legitimate applications. "Few things are good for everything, most things are good for something." To this electricity is no exception, and our chief aim will be to discriminate between its well and its ill advised application. Our added space enables us to treat the subject without encroaching upon other matter.

Finally, as to personnel, the business management and control of the paper is beginning with this number in the hands of Messrs. Angus Sinclair and John A. Hill, who have made such a decided suc-

cess of their paper, "Locomotive Engineering." Mr. Sinclair is well known to many of our readers, having been at one time associate editor of this paper. Mr. Hill also needs no introduction, having been formerly one of our most valued contributors. These gentlemen have demonstrated that they know how to manage the business affairs of a progressive technical journal.

The editorial department will remain in charge of the same individual who has been trying for the past year or so to keep it on the right track, and who has been one of the paper's editors for something over eight years. His principal assistants will be Mr. Frank Richards, who needs no introduction to our readers, and Mr. Frederick A. Halsey, who is also well known to them. Both these gentlemen have been contributors, and both are writers of recognized ability on mechanical subjects.

The "American Machinist" expects to have a happy and a prosperous New Year, and we hope the year will be equally happy and prosperous for all our friends.

We do not by any means believe that a very large proportion of the people of this country think that patriotism consists in hating England and in going about with a chip on one's shoulder bragging about how easily we could vanquish any other three nations on the face of the earth. But the small minority who do seem to thus regard it have, it seems to us, recently been entirely too vociferously prevalent.

General Miles uttered some wholesome truths the other day in Philadelphia when he stated that not one single modern gun was in position between that city and the sea, and it is distinctly noticeable that no bragging has been done by army or navy officers, who know something of what a war between us and England would mean. It would not mean a picnic for us and the burden and the sorrow of it would, in the end and in the main, fall upon those least able to bear them. It is as good for a nation to mind its own business and avoid quarrels, so long as consistent with honor and safety, as it is for an individual to do the same, and a war with England would be a calamity and a crime which would impede the growth of civilization for a century. Many of those who have been yelping for war and who estimate their own patriotism by the loudness of their yelp have shown little or no disposition to be practically patriotic by attending quietly to the every-day duties of citizenship.

Many of our readers have regretted that they know so little of electricity, and that they find so little literature on the subject that is easily understandable.

In our department of electricity, Mr. Mason, who is a long time reader and friend of the "American Machinist," and understands the spirit of its constituency, commences a series of articles in which he will attempt to make the subject clear, and as his articles will be addressed especially to machine constructors, we would strongly advise all of them who wish to acquire a general knowledge of the subject, to read the articles carefully. Such a reading will prepare those unfamiliar with the subject to better understand the other matters that will be published in that department, and any one who will put forth only a small part of the effort to understand the articles that their author is making to simplify and illumine the subject will find himself in possession of a good general knowledge of electricity.

Some of our readers will receive their papers later this week than usual. That is because we shall hereafter hold our forms open later, on account of our commercial report and because the paper will be the better for it generally. We shall finish the mechanical work on the paper the day before issue, and will then distribute it as rapidly as possible. The actual time intervening between preparation of matter and our readers receiving it will in fact be shortened by the new arrangement.

Questions and Answers.

Name and address of writer must accompany every question

Questions must pertain to our specialties and must be of general interest.

We cannot undertake to answer questions by mail.

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(1) A. A., Beloit, Wis., writes: Kindly give us the dimensions for a 10-ton and a 12-ton crane hook. A.—For a 10-ton crane hook the dimensions are as follows: From the center of eye to center of the opening of hook, 8⅛ inches; diameter of opening, 4¼ inches; greatest diameter of metal at the bend of hook, 3⅜ inches; diameter of shank, 1¾ inches. For a 12-ton crane hook the above dimensions are, respectively, 8⅞, 4⅝, 3⅝ and 1⅞ inches.

(2) E. T., Philadelphia, encloses sketches, which we need not reproduce, of a solid die and of a die split at one side, and says: Kindly inform me how to proportion taps and dies. A.—The dimension lines on the sketches seem to ask for the thickness of die, outside diameter of round die, side of square die, thickness of "land" or thread part of die, size of chip space, etc. Though no sketch of tap is given, similar dimensions are, presumably, required for it. This seems to call for a complete treatise upon tap and die making, which our space, of course, will not permit. The best way would seem to be to observe the best existing samples of taps and dies, and to improve upon them as much as possible. Any investigation would show that there is no established practice, and none should be expected, because the materials and other conditions of employment vary so widely.

(3) A. D., Glasgow, Scotland, writes: I have three screws to cut, viz: One 1¾ inch diameter, with 10.95 threads to the inch; one 1⅝ inch diameter, with 9.95 threads to the inch; one 1½ inch diameter, with 8.95 threads to the inch. Kindly say what gears will cut these threads, leading screw being three threads. A.—The gears can be found by simple proportion. Assuming a gear of thirty teeth for the stud gear, we state the case like this:

$$3 : 10.95 : : 30 : 109.5$$

Here a gear of 109.5 teeth is required, which is impossible, but if we double it and double the stud gear also, we will have 60 and 219 as the gears required. It will be noticed that both of these numbers are divisible by 3, so that 20 and 73 will cut 10.95 threads. We get at the other two threads in the same way:

$$3 : 9.95 : : 60 : 199$$
$$3 : 8.95 : : 60 : 179$$

The gears 60 and 199, therefore, will cut 9.95 threads, and 60 and 179 will cut 8.95 threads, and as these gears have no common divisor they cannot be reduced.

(4) J. D. T., Coxsackie, N. Y., asks: Is there any possibility of driving a shaft by means of spur gears; the driven shaft is not parallel to, nor in the same plane with the driving shaft? In other words, is there any known way of obtaining steady and even circular motion under the above conditions by means of spur gears? A.—You cannot use spur gears under the conditions named. But you can get satisfactory results with gears specially made for the purpose. 2. Is there any means by which the gears can be prevented from sticking, or binding of the teeth prevented at certain portion of the revolution, and eventually be destroyed? A.—Gears with teeth correctly designed will not bind; of course gears will wear to some extent, and will have to be replaced in time. Sometimes in two geared wheels an extra tooth is used in one of them, by means of which the order of contact of the teeth is changed at every revolution. 3. If I understand correctly, spur gears are those which have the teeth parallel to the axis of the cylinder. The form of teeth most commonly used is of the epicycloidal or double curve type. A.—Your definition of spur gears is correct, and from this definition it follows that they can be used for parallel shafts. It is true that the epicycloidal teeth are often used, but the involute teeth have also their advocates, and are extensively employed.

(5) H. M., South Boston, Mass., writes: I have a copper boiler, double-riveted with spherical heads; seams have ¼-inch rivets; the copper in cylindrical shell is ½-inch thick, its tensile strength is 30,000 pounds. The heads are made of copper, $\frac{13}{16}$-inch thick. Will the cylindrical shell stand a working pressure of 90 pounds per square inch, and the heads 100 pounds per square inch? A.—If the rivets in the shell are properly spaced and the workmanship is first-class throughout, the shell will stand an internal pressure of 90 pounds per square inch. The heads are strong enough for 100 pounds per square inch. 2. Will a flue boiler of the following dimensions stand a safe working pressure of 187 pounds? Diameter 48 inches, shell of steel ¼ inch thick, transverse seams single-riveted, longitudinal seams double-riveted. Two flues 15½ inches diameter, of steel $\frac{5}{16}$ thick, 60,000 pounds tensile strength; they are made in sections about 36 inches long and riveted together. A.—The shell is not strong enough to safely stand this pressure. If the flues are of the Adamson's type they are strong enough. 3. We have 120 square feet of heating surface in the two flues, and 96 square feet in the shell, giving us a total heating surface of 216 square feet; dividing this by 8 will

give us 27 horse-power. Is this right? 1A.—The term "horse-power of a boiler" is a very indefinite one, and then, again, the rate of evaporation per square foot of heating surface for different types of boilers varies within such wide limits as to practically render worthless the rules bearing on the subject. But since it is convenient for boiler makers to have some means for rating the horse-power of boilers, the rule you have given will give fairly close approximation of this type of boiler. The standard adopted by the American Society of Mechanical Engineers is 34½ pounds of water evaporated from and at 212 degrees Fahr. per hour. The method of computing the horse-power of a boiler according to this standard is fully explained in our issue of December 6, 1894, in answer to Question 558. 4. If I had a boiler to build 36 inches diameter and 30 feet long, made of steel $\frac{5}{16}$ inch thick, tensile strength 60,000 pounds per square inch, single riveted, rivets $\frac{5}{8}$ inch diameter, pitch 2 inches, heads of a good quality of cast iron $1\frac{7}{16}$ thick, would such a boiler stand safely a working pressure of 173 pounds? A.—No; the shell is not strong enough, and cast-iron heads are dangerous; cast iron should never be used for this purpose. We should advise you to have the boiler designed by a good mechanical engineer. 5. In computing the heating surface of tubes, do you take the outer or inner surface? A.—We always take the outer surface. Some engineers insist that the inner surface should be taken. 6. Will a corrugated furnace flue 40 inches diameter, corrugation 1½ inches deep, 8 inches from center to center, plain part at the end 6 inches long, made of steel $\frac{5}{16}$ inch thick, stand a pressure of 175 pounds with safety? A.—The general rules and regulations prescribed by the Board of Supervising Inspectors of Steam Vessels give the following rule: The strength of corrugated flues, when used for furnaces or steam chimneys (corrugation not less than 1½ inches deep), and provided that the plain parts at the ends do not exceed 6 inches in length, and the plates are not less than $\frac{5}{16}$ inch thick, when newly corrugated and practically true circles, to be calculated from the following formula: $\frac{12,500}{D} \times T$=pressure per square inch. In which T=thickness in inches, and D=mean diameter in inches. According to this rule the flue of the dimensions given by you will not withstand safely a pressure of 175 pounds. 7. Will a steel head 36 inches diameter, ½ inch thick, and flanged and riveted to end of the boiler, stand a safe pressure of 44 pounds per square inch without any bracing of any kind. A.—No; boiler heads without any bracing is bad practice. 8. How high up on the tubes should the heating surface in an upright boiler be taken? A.—Up to the water line. 9. Will one-fifth less than the area of all flues in an upright boiler be correct for the area of the smokestack? A.—The cross-sectional area of the smokestack should be one-eighth of the area of the grate surface.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear Wheels, Gear Cutting. Grant: see page 38.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Patents, write Walter Donaldson & Co., Wash. D.C.

Model making and electrical experimental work. F. W. Gardam & Co., 58 Ann st., N. Y.

Marine Iron Works, Chicago, builders of steam yachts and marine machinery; catalogs free.

Best Presses and Dies for all sheet metal work. Ferracute Machine Company, Bridgeton, N. J.

Engine castings, ⅛ H. P. up; best designs, finest castings. Catalog. Grant Sipp, Paterson, N. J.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Just issued—Catalog No. 8. Mailed Free. Clayton Air Compressor Works, 28 Cortlandt st., New York.

Key Seaters for any length of hub or width of keyway. New, handy machines. Mitts & Merrill, 913 Tilden street, Saginaw, Mich.

Squaring and Rotary Shears, Tinsmiths' Tools, Presses and Dies for sheet metal work, are made by the Niagara Stamping and Tool Co., Buffalo, N. Y.

Thin emery wheels, for cutting slots, etc., a specialty. The Tanite Co., Stroudsburg, Pa.; 161 Washington street, New York; 139 East Pearl street, Cincinnati, O.

Duplex and special gear cutters, imp. counterbores, cutter and surface grinders, vertical millers, hand punches and shears for sheet metal. R. M. Clough, Tolland, Conn.

"Practical Drawing," by J. G. A. Meyer; used by engineering schools in lieu of text-books; the set of 92 papers sent to any address in the United States for $5. AMERICAN MACHINIST, 203 Broadway.

Three valuable books by Prof. N. Hawkins—"Calculations," $2.50; "Instructions for the Boiler Room," $2.50; "Aids to Engineers' Examinations," $2. Sold on installments. Write for terms and catalog. TESTIMONIAL—"These books are invaluable to a busy man. Have just what is needed, and where it can be found."—Engineers' Office, Cairo City Gas Company, Cairo, Ind., December 4, 1895.—W. S. RATHELL, Engineer. Theo. Audel & Co., 91 Liberty street, New York.

COMMERCIAL REVIEW.

NEW YORK, FRIDAY EVENING, DEC. 27.

Electrical Machinery.

Since, with the present number, the "American Machinist" introduces, as one of its features, the subject of electrical machinery, so far as related to the interest of its readers, a brief consideration of the commercial conditions prevailing in this industry may not be inappropriate.

The many manufacturers of dynamos, motors and other electrical goods report their business of the past year to have been better than that of the year preceding, so far as the volume is concerned, but at the lowest prices ever known. As to the extent of the improvement, experiences vary, but trade has not regained the footing it held before the financial depression, unless in exceptional cases. The past few months have been those in which trade normally is active, and the first two of the opening year may be relatively a little dull; but the general prospects for 1896 are bright, and a decidedly stronger undertone prevails than at this time last year.

At present there is a tendency to advance prices from the extremely low level to which they fell, and some of the leading companies have already taken action in this direction. Others will probably follow, and others are holding steady, while still others assert that prices are tending downward rather than upward. The solution of all this seems to be that, while the stronger companies can hold prices, some of the weaker ones are forced to cut in order to get business. The higher cost of raw material earlier in the season left small margins of profit to sellers of electrical machinery.

Among the various classes of goods for which, in one quarter or another, a fair trade is reported, may be mentioned alternating current dynamos, to be used for lighting purposes and for running motors in the same circuit. Motors for use in shops in connection with electrical transmission of power, and to be employed in cases where hitherto steam engines would have been availed of, are also gaining popular favor. Mr. Chas. D. Shain, general Eastern agent for Siemens & Halske, reports machinery for street railway and electrolytic purposes as prominent features of his trade.

The General Electric Company has done a large business during the past year. Some new features of its work are long distance transmission for interurban service, application of electricity to steam roads, and the combination of lighting and power already referred to.

The Fort Wayne Electrical Corporation states that it is more than busy, notably so in connection with the extension of already existing arc light equipments. Its prices are steady.

H. B. Caho & Co., selling agents for the Eddy and various other companies, say concerning the situation: "Motors are not quite so low as they were. There is a tendency to hold up prices. The best outlook is in the small motor business: those of 5-horse power sell so rapidly that we cannot keep them in stock. People want a better class of goods than heretofore; among other things, in arc and incandescent lamps. The coming feature seems to be electric transmission of power. A favorite arrangement in shops is to run the several pieces of machinery by belts, as formerly, but connect the various floors of the building with the source of power by electricity. The economy of electricity is beginning to be recognized. A field for it is also opening in illuminated signs."

It is not safe to predict how much electric railway work the coming year will see, but there are probably many horse-car roads ready for transformation if the public elects so to invest its capital, rather than in government bonds. The conditions of finance may, therefore, have a considerable influence upon electrical machinery.

Copper wire and cables, some three months ago, were up 33⅓ per cent., following suit with copper. Now a large part of the advance has been lost, and, if copper continues to decline, we may see still lower prices in these lines, which are dependent upon it.

Iron and Other Metals.

The iron market is like a boat always pointing up stream, but continually drifting down with the tide. This week is an acme of dullness. There are few buyers, yards are full, and much iron is drifting

around undelivered. Bessemer pig is now quoted at $10.75 Valley furnace, which is getting pretty near its price before the advance. An announcement which may afford some slight ray of hope of higher prices is that a prominent coke company has fixed upon $2.30 per ton for foundry coke, f. o. b. furnace.

Copper continues to weaken. Spelter is stronger, owing to the flooding of western mines. Tin is still lower, and the same is true of lead.

The following, quoted by the trade this evening, represent prices on iron and other metals, generally in force at the close of the week:

QUOTATIONS.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$13 25@ $14 00
No. 2 foundry, Northern	12 50 @ 13 00
No. 2 plain, Northern	12 00 @ 12 50
Gray forge, Northern	12 00 @ 12 25
No. 1 foundry, Southern	13 50 @ 14 00
No. 2 foundry, Southern	13 00 @ 13 50
No. 3 Southern	12 50 @ 13 00
No. 1 soft, Southern	13 00 @ 13 50
No. 2 soft, Southern	12 50 @ 13 00
Foundry forge, Southern	12 00 @ 12 25

Bar Iron—Common, on dock, $1.35 @ 1.40, mill prices for carloads; $1.60 for small quantities out of stock; refined, on dock, $1.50 @ 1.60, mill prices for carloads; $1.70 @ 1.80 for small quantities out of stock.

Scrap Iron—No. 1 yard wrought, f. o. b., $12.50.

Tool Steel—Ordinary sizes, standard quality, 5¾ @ 7c.; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—$1.85 @ 1.95 for ordinary brands. Special brands upward.

Cold Rolled Steel Shafting—Base, 2½c. in carloads; 2¾c. in smaller quantities; 3c. from store.

Copper—Lake Superior ingot, 10¼c.; electrolytic, 10c.; casting copper, 9¾c.

Pig Tin—In carloads, $13.75. Friday's closing quotations on the Metal Exchange for quantities not less than five tons were: $13.60 @ 13.70 for December; $13.55 @ 13.65 for January to June.

Pig Lead—In carloads, $3.15.

Spelter—Western brands, $3.55 @ $3.60, New York delivery.

Antimony—In wholesale lots, Cookson's, 7¾ @ 8c.; Hallett's, 6⅞ @ 7c.; Japanese, 6¾ @ 6⅞c.

NEW CATALOGS.

There are three sizes of Standard Catalogs, 9"X12", 6" X 9" and 4½" X 6". We recommend the 6" X 9" size for machinery catalogs. When they must be larger or smaller, one or the other standard sizes should be adopted if possible.

Lodge-Davis Machine Tool Co., Cincinnati, O., send us a pamphlet illustrating a new form of hub and cone machine for making the hubs and cones of bicycle wheels.

The Piqua Handle & Mfg. Co., Piqua, O., send illustrated catalog and price list of various wooden handles, such as for door knobs, chisels, awls and other wooden tool handles.

The Fenton Metallic Mfg. Co. send us a catalog describing and illustrating the Fenton bicycle, the features of which are set forth in the catalog by fine engravings and letterpress. It is 6¾"x5".

The Babcock Printing Press Mfg. Co., New London, Conn., have issued a catalog illustrating and describing improved printing presses of their manufacture intended for various classes of work.

The Hogan Boiler Co., Middletown, N. Y., have issued the third edition of their pamphlet entitled "Truths and Proofs," in which are set forth points of information and records of experience in the use of the Hogan water-tube boiler. It is sent on application and is 7"x9¾".

The Joseph Dixon Crucible Co., of Jersey City, N. J., send us a pamphlet entitled "Hints of What We Manufacture in Graphite." In this pamphlet will be found an account of a number of things made of graphite that are of especial interest to machinery and other manufacturers, and it will be sent to all applicants. It is 3¼"x6".

Messrs. John Wiley & Sons, publishers, New York City, have issued a catalog of scientific textbooks and industrial works, which contains tables of contents, with accounts of the leading and latest books issued by them pertaining to the various branches of machine construction and other industrial operations. It is 6"x9¾".

The Hiles & Jones Co., Wilmington, Del., issue a new catalog devoted especially to machine tools for working iron and steel plates, bars and structural shapes. It is illustrated with a large number of good half-tone engravings, which give an excellent idea of the construction and appearance of the various punching, shearing, rolling and other machinery built by them. It is 8⅝"x 11⅞".

MANUFACTURES.

Transue & Williams, of Alliance, O., have just completed a plant in that city for the manufacture of drop forgings.

C. N. Newson and others have formed a company, with a capital of $20,000, to manufacture a new style of bicycle, at Anderson, Ind.

The Schofield Bolt Works, Anderson, Ind., after two years' idleness, is now busier than ever. Much of the plant is reset with new machinery.

The Fulton Bag and Cotton Mills, at Atlanta, Ga., have ordered fifty-five carding engines from the Howard & Bullough American Machine Co., Pawtucket, R. I.

The American Mfg. & Construction Co., Baltimore, Md., has been incorporated by S. Davis and others to manufacture machinery for commercial and other uses. Capital, $100,000.

Frederick Dodge, 502 S. West street, Syracuse, manufacturer of special machinery, has now taken up the manufacture of high-grade bicycles and installed new and best improved machinery.

A new company has been formed at Oakland, Me., which has a capital of $300,000, and is to be known as the Rogers Iron Works. It will make a complete line of general tools for machine shop use.

The Deane Steam Pump Co., of Holyoke, Mass., was recently awarded first premium for the best collection of pumping machinery at the Chilian Exposition of Mines and Metallurgy, held at Santiago, Chili.

The H. H. Franklin Mfg Co., of Syracuse, N. Y., has formed to make metal castings and other goods. The directors are Messrs. Robert R. Franklin, James Pass Geddes, Albert P. Seymour, Henry K. Chadwick and G. H. Stilwell, of Syracuse. Capital, $100,000.

The Lodge & Davis Machine Tool Co., of Cincinnati, O., have just closed a large deal, through their English agent, with an extensive bicycle manufacturer of Coventry, England. The contract specifies the complete equipment of the plant and will consist of several carloads of machine tools.

Thomas G. Oakes, who for many years has been connected with the house of Jenkins Bros., of New York City, will open a store at 52 John street, where he will engage in a similar line of business; that is, he will supply valves, packing, etc., and will also handle the goods of the Mason Regulator Co., of Boston, Mass.

The Alexander Smith & Sons Carpet Co., of Yonkers, N. Y., have placed the contract for their new dye-house building with the Berlin Iron Bridge Company, of East Berlin, Conn. The building is 60 feet wide and 172 feet long, the steel roof trusses being arranged to carry cars on the lower chord for moving material about the building.

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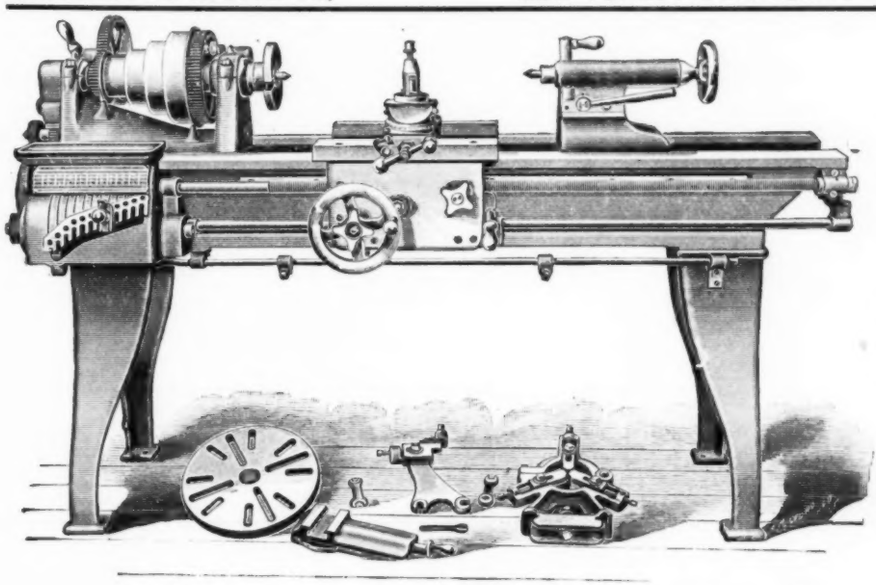

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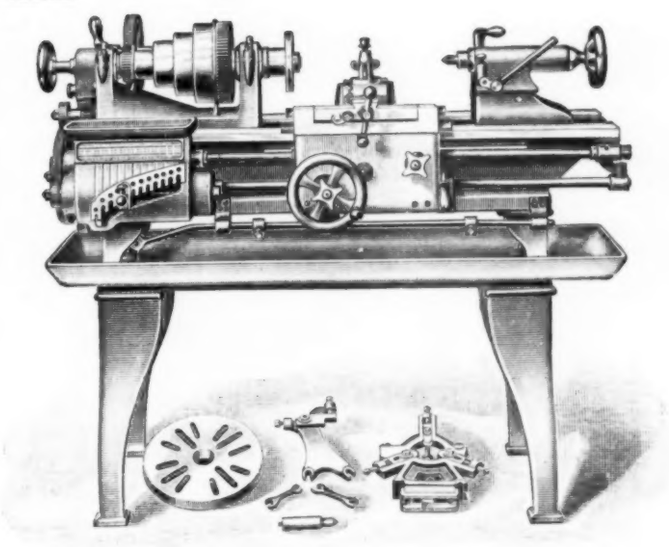

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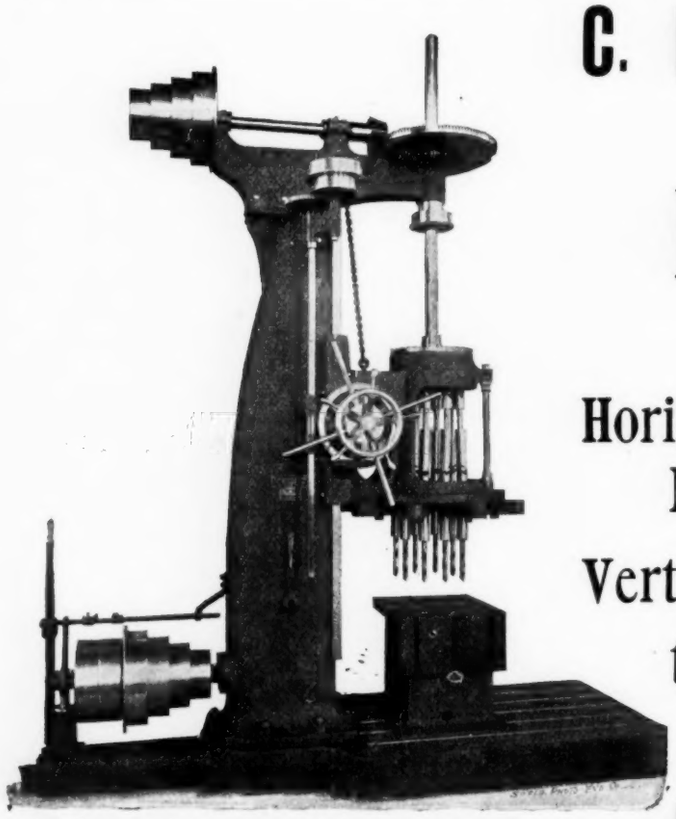

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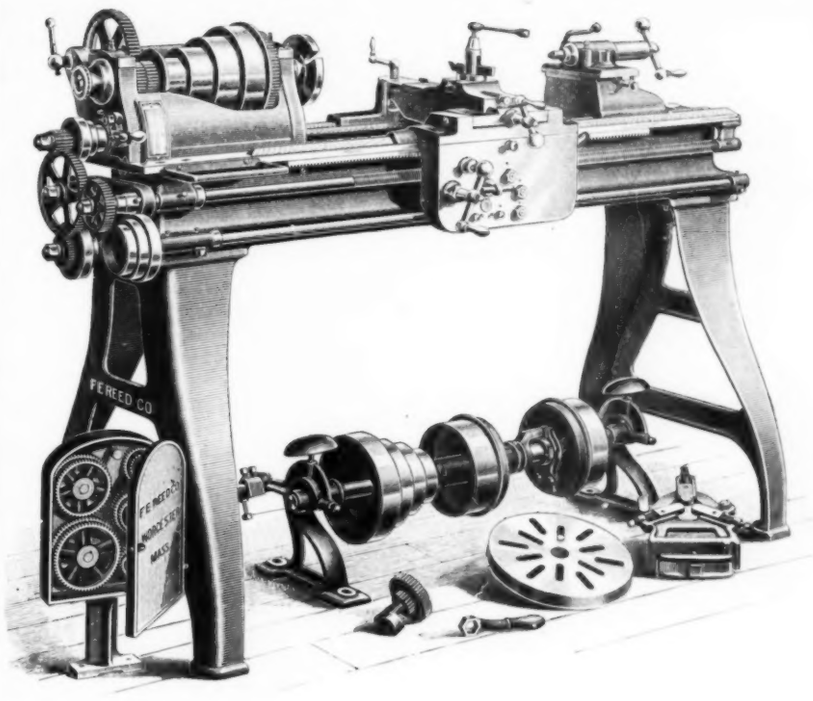

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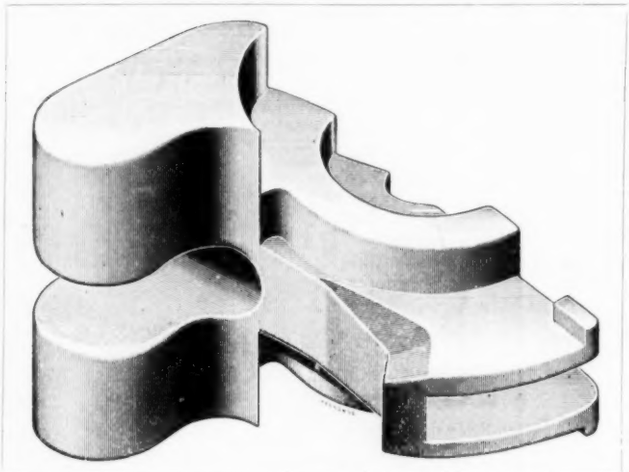

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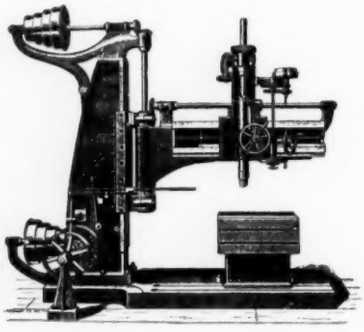

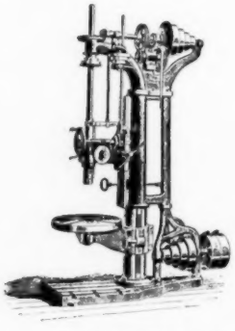

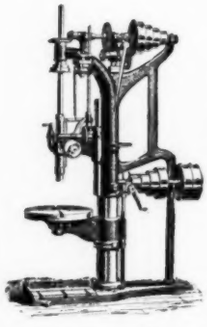

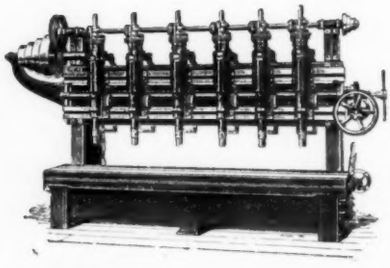

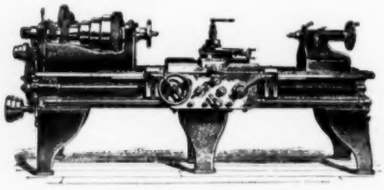

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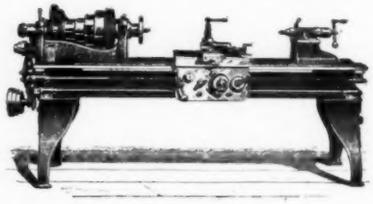

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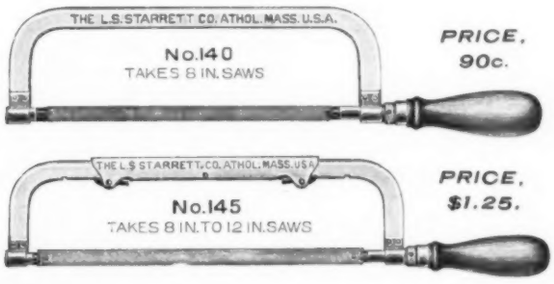

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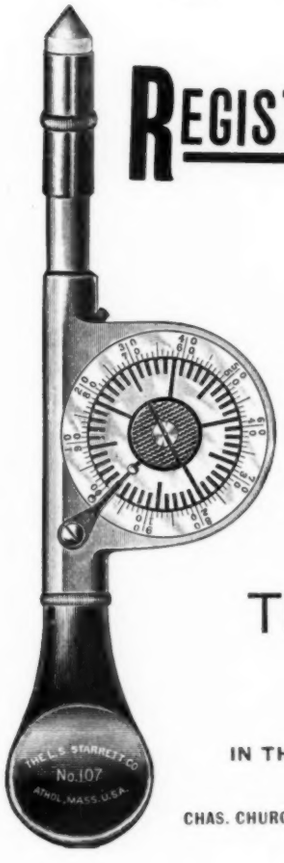

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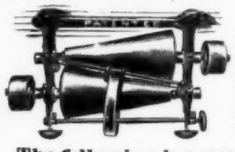

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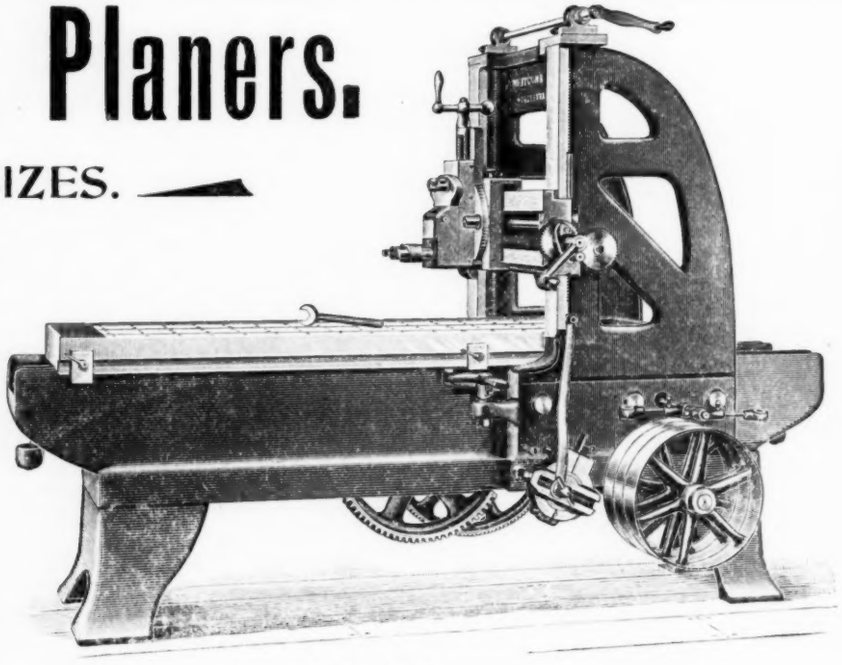

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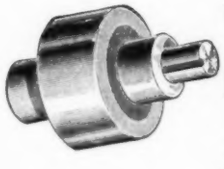

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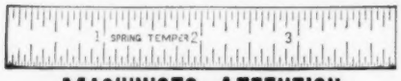

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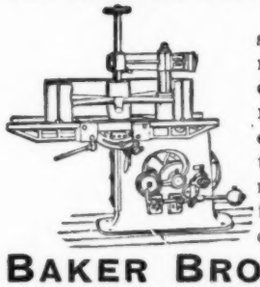

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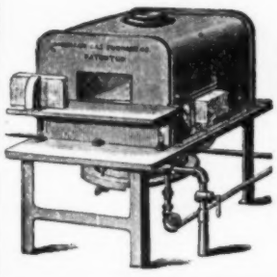

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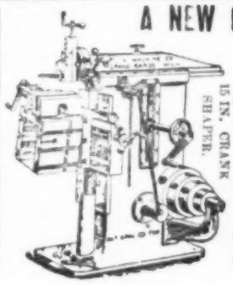

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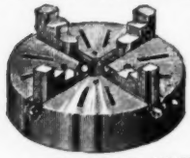

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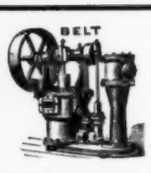

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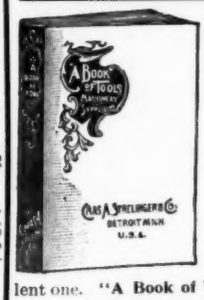

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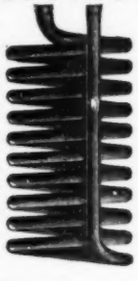

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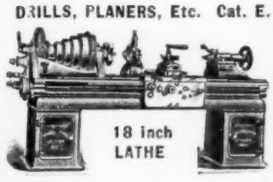
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POLISHING WHEELS,
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PROVIDENCE, R. I.

MEYER, ROTH & PASTOR,
Machinists, Cologne o/Rhine, Germany.
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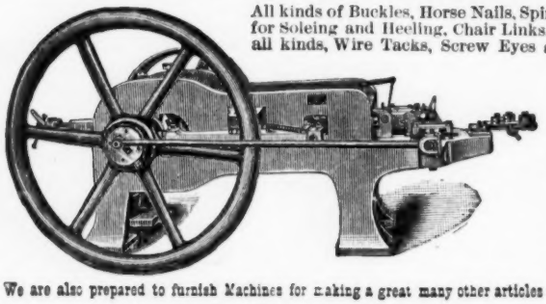
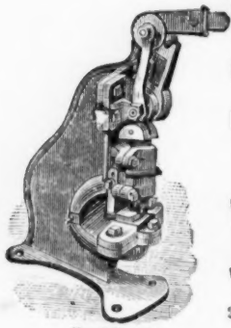

All kinds of Buckles, Horse Nails, Spiral Springs, Tin-opening Keys, Nails for Soleing and Heeling, Chair Links, Box and Coffin Handles, Rivets of all kinds, Wire Tacks, Screw Eyes and Screw Hooks, Cramps, Hinges, Lock and Piano Nails, Hob Nails of all kinds, Corset Buttons, Sliding Bolts, Eyes, Loops, Leaden Rivets, Leads, Spring Bands, Square Nails for Heeling; Wire Bending and Wire Cutting Machines, Shaping Machines, Machines for making Hooks and Eyes for Ladies' Dresses, Trowsers Hooks and Trowsers Eyes, as well as Hooks and Eyes for Military Cloaks; Tacks and Rivet Presses, etc.
We are also prepared to furnish Machines for making a great many other articles not mentioned above, on receipt of Samples.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HYDRAULIC MACHINERY,
PRESSES, PUMPS,
PUNCHES, JACKS,
VALVES, FITTINGS,
PACKINGS,
ACCUMULATORS.
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Proprietors.
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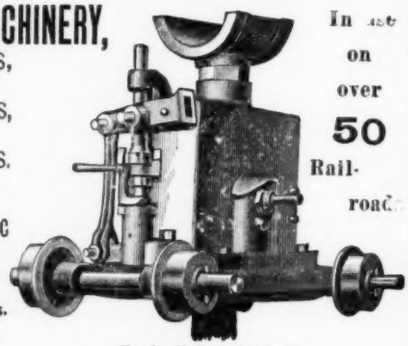
NEW YORK.

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For BICYCLE, Electrical and All Sheet Metal Work.
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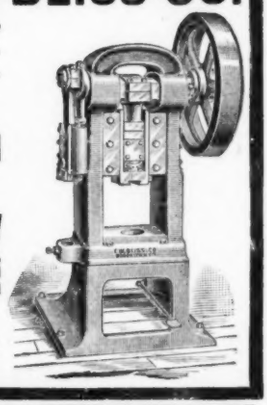

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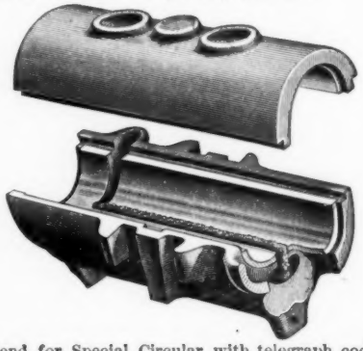
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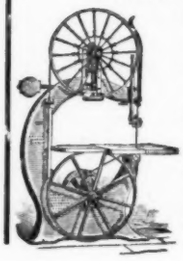
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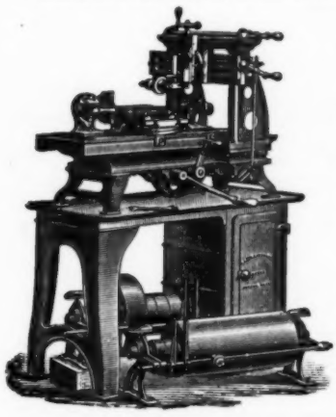

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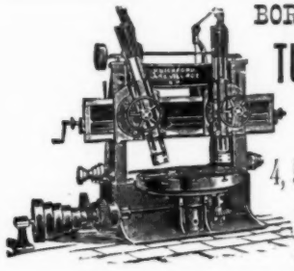

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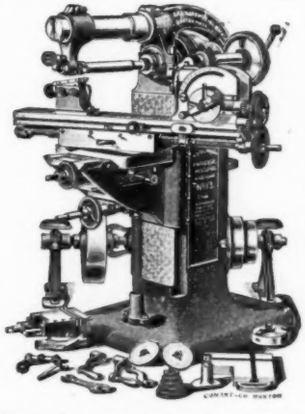

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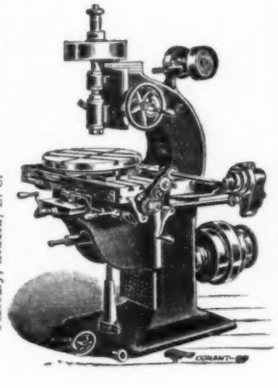

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[We think them without an equal] as well as of

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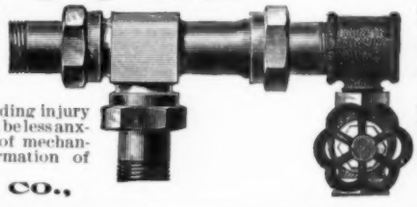
[It uses warm water, avoiding injury to boiler, and facilitates raising steam] we should be less anxious to get our Illustrated Catalogue into the hands of mechanical men everywhere. The pamphlet contains information of value, and you are invited to send for it.



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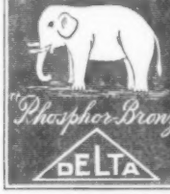

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60	inch by	60	inch by	12	feet.
48	" "	48	" "	12	"
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15	" "	15	" "	4	"

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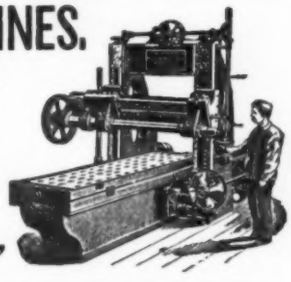

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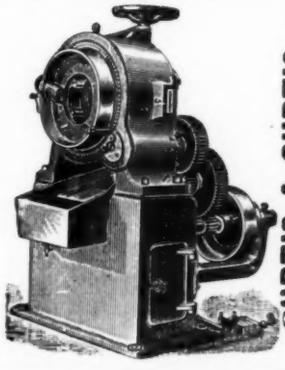

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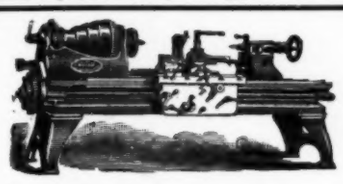

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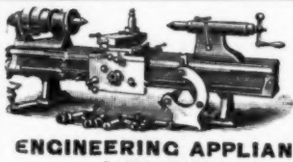

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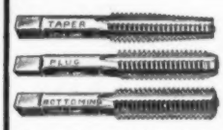

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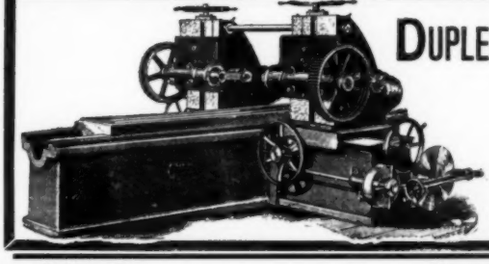

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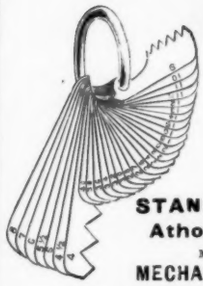

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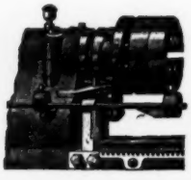

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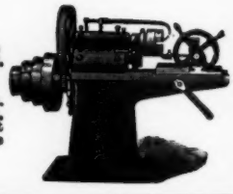

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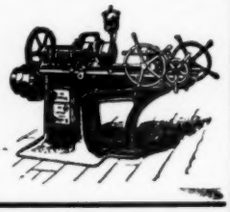

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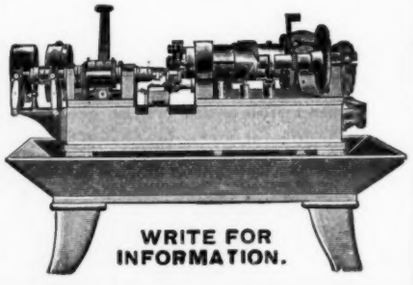

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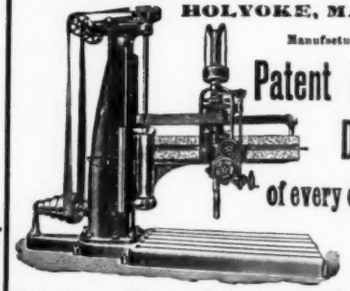
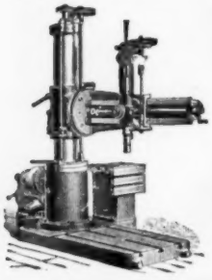


All sizes from 3 ft. to 10 ft. arm.



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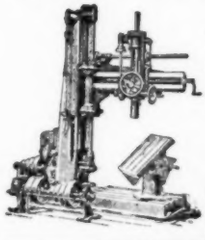

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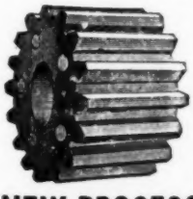

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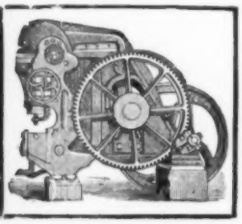

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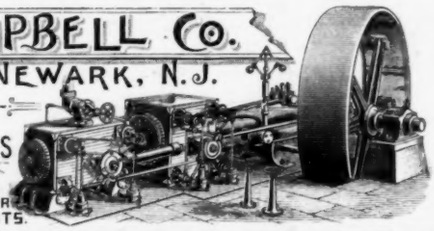

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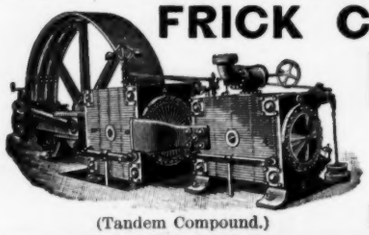

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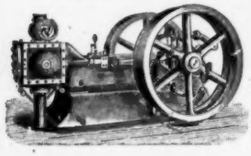

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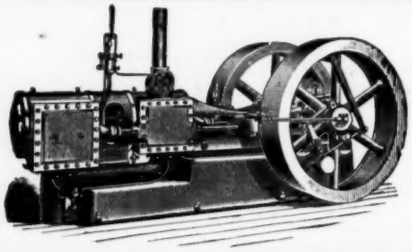

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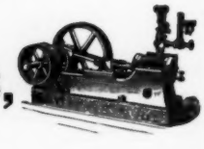

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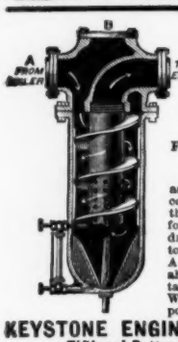

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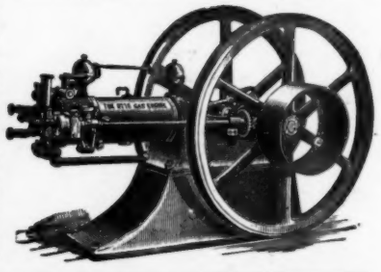

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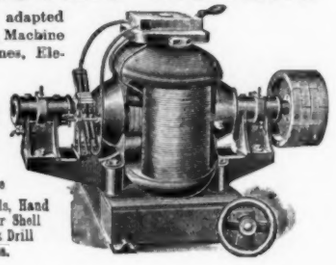
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